SIEMENS

MAMMOMAT Balance

SP

Troubleshooting Guide

Service Instructions (incl)

English
Doc. Gen. Date: 10.04

Print No.: SPB7-115.840.01.02.02

Replaces: SPB7-115.840.01.01.02

Chapter	Page	Revision
all	all	02

Document revision level

The document corresponds to the version/revision level effective at the time of system delivery. Revisions to hardcopy documentation are not automatically distributed.

Please contact your local Siemens office to order current revision levels.

Disclaimer

The installation and service of equipment described herein is to be performed by qualified personnel who are employed by Siemens or one of its affiliates or who are otherwise authorized by Siemens or one of its affiliates to provide such services.

Assemblers and other persons who are not employed by or otherwise directly affiliated with or authorized by Siemens or one of its affiliates are directed to contact one of the local offices of Siemens or one of its affiliates before attempting installation or service procedures.

Contents

Contents

List of Fuses

FUSE HOLDERS

F1	10 x 38	gG 20A
F2	10 x 38	gG 20A
F3	6 x 30	CT 3.15A
F4	6 x 30	CT 3.15A
F5	6 x 30	CT 500mA
F6	10 x 38	gG 10A
F7	5 x 20	CT 40mA
F8	6 x 30	CT 100mA
F9	10 x 38	gG 10A
F10	6 x 30	CT 10A
F11	6 x 30	CT 4A
F12	6 x 30	CT 100mA

PCB 03-186

F1	5 x 20	CT 500mA
F2	5 x 20	CT 500mA

PCB 03-188

F1	5 x 20	ET 1.6A
F2	5 x 20	ET 1A
F3	5 x 20	CT 0.5A
F4	6.3x 32	GT 2A
F11	5 x 20	ET 3.15A

PCB 92-073

F1	6.3x 32	GT 1.6A
F2	6.3x 32	GT 1.6A

PCB 92-074

F1	6 x 30	CT 10A
F2	6 x 30	CT 4A
F3	5 x 20	CT 40mA

INVERTER PCB 94-132

F2	5 x 20	CT 1A
F3	BUSSMANN B1000 20FC 20A 660V	

DIP switches

PCB 01-170 Main CPU

SW1		
DIP1 =	**ON**	Anode current calibration mAH
DIP2 =	**ON**	Anode current calibration mAL
DIP3 =	**ON**	DEMO mode without x-ray
DIP4 =	**ON**	Pulsed radiation disabile with grid table
DIP5 =	**ON**	AEC frozen to single Film/Screen
DIP6 =	**OFF**	Not in use, must remain OFF
DIP7 =	**ON**	Compression force calibration
DIP8 =	**ON**	Mo/Rh filter enabled

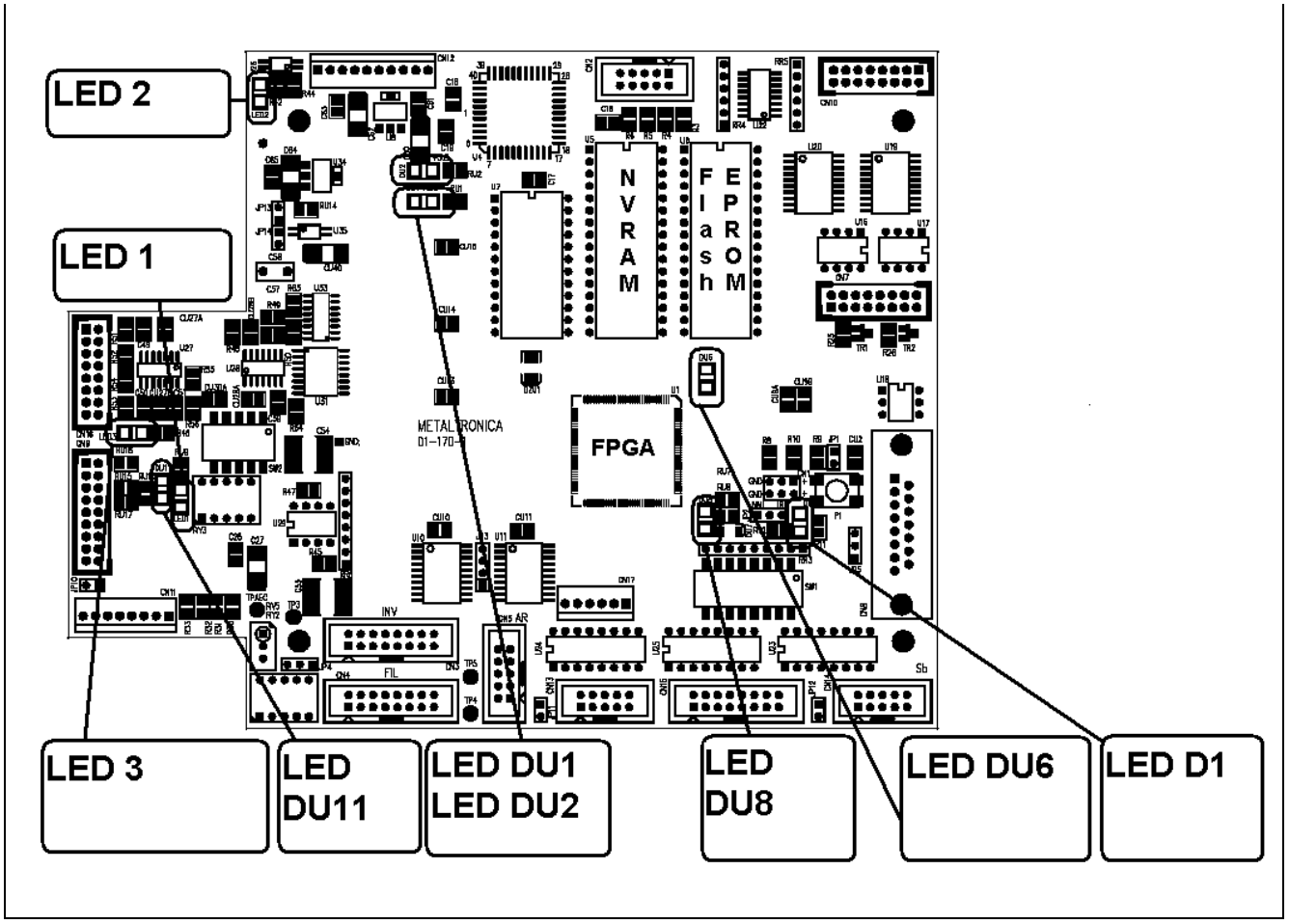
SW2		
DIP1 =	**ON**	C-arm Brake, disabled for service
DIP2 =	**ON**	Inverter Vdc input sense disabled
DIP3 =	**ON**	Max compression force 200N
DIP4 =	**ON**	Exposure start on left to right grid movement
DIP5 =	**OFF**	Future expansion

PCB 92-083 Keyboard

Language	DIP1	DIP2	DIP3	DIP4
Italian	OFF	OFF	OFF	OFF
French	**ON**	OFF	OFF	OFF
English	OFF	**ON**	OFF	OFF
German	**ON**	**ON**	OFF	OFF
Spanish	OFF	OFF	**ON**	OFF
Polish	**ON**	OFF	**ON**	OFF
Turkish	OFF	**ON**	**ON**	OFF
Portuguese	**ON**	**ON**	**ON**	OFF

Control LEDs

CPU 01-170



	Color	Function
LED1	YELLOW	Don't care
LED2	YELLOW	blinking during x-ray
LED3	YELLOW	bright during x-ray (mAs meter pulses)
LED D1	RED	IRQ activity monitor, blinks in normal condition; if bright fix CPU hanged UP
LED DU1	YELLOW	internal +2,5Vdc
LED DU2	YELLOW	internal +3,3Vdc
LED DU6	RED	ON at start UP during FPGA initialization
LED DU8	RED	ON during CPU initial reset
LED DU11	YELLOW	+5Vdc

CPU Reset sequence

At power ON, LED DU6 and LED DU8 are bright, LED DU8 goes OFF, LED DU6 goes OFF, LED D1becomes bright fix and after blinks to indicate that CPU is running.

Motherboard 03-188

	Color	Function
DL1	GREEN	-15Vdc
DL2	GREEN	+15Vdc
DL3	GREEN	+24Vdc
DL4	GREEN	+5Vdc
DL5	RED	bright with x-ray pushbutton pressed
DL6	GREEN	-15Vdc delayed at power ON
DL7	GREEN	+5Vdc
DL8	RED	CPU / Table driver communication monitor, blinks in normal condition, bright fix during grid movement.

Anode starter 92-074

	Color	Function
LED1	YELLOW	Bright during tube running
LED2	YELLOW	Bright during brake or alarm
LED3	YELLOW	Bright during brake
LED5	GREEN	Bright in Stand by or rotation
LED6	GREEN	Bright during rotation

Filament power supply PCB 92-073

	Color	Function
LED1	GREEN	Bright fix in normal condition
LED2	RED	don't care
LED3	RED	Bright when Small focal spot is selected
LED4	GREEN	Bright with filament ON
LED5	YELLOW	bright during exposure. Brightness is directly proportional to anode current

Inverter control board 94-132

	Color	Function
DL1	GREEN	**+15Vdc**
DL2	YELLOW	bright or blinking during exposure depending on continuous or pulsed mode

Subassemblies and PCB replacement

When replacing subassemblies and/or PCB, take care of calibration or Firmware version according the following table :

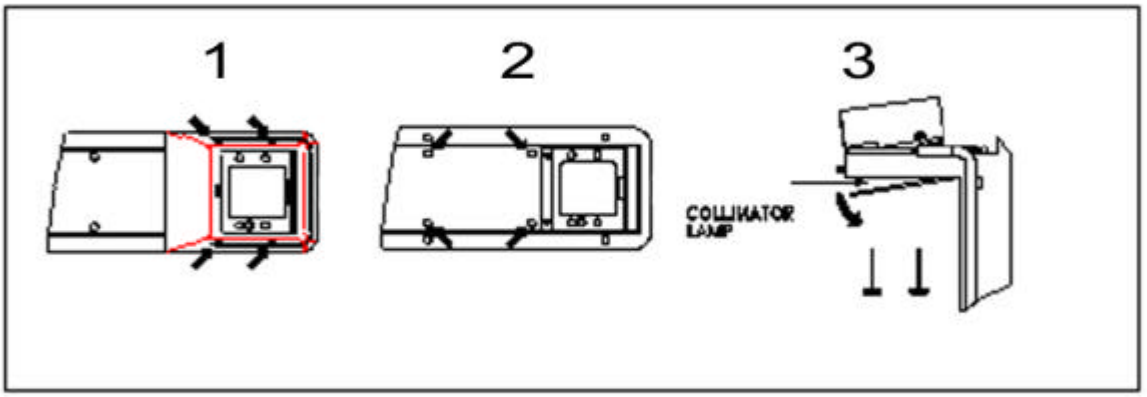
SIEM.code	MTL code	Part description	Calibration	Firmware
08883402	DS/INVC132	Display SP14N003 power supply	NO	NO
08883410	DS/LMG7401	SP14N003 DISPLAY	NO	NO
08883436	KTFLA0206	INVERTER module	**Note (1)**	NO
08883444	KTFLI0009	H.V. Transformer	**Note (1)**	NO
08883451	PCB/01-170-X	CPU Board	NO	**YES**
08883469	PCB/02-171-0	TUBE Temperature sensor	NO	NO
08883477	PCB/02-179-X	C-ARM Service board	NO	**YES**
08883485	PCB/03-181-X	CPU Keyboard	NO	**YES**
08883493	PCB/03-186-X	Service board	NO	**YES**
08883501	PCB/03-187-X	Serial port connectors board	NO	NO
08883519	PCB/03-188-X	CPU Mother board	**YES**	**YES**
08883527	PCB/92-073-X	Filament power supply	**YES**	NO
08883535	PCB/92-074-X	Anode starter	**YES**	**YES**
08883543	PCB/92-083-X	Keyboard	NO	NO
08883550	PHTM9000	AEC Detector	**YES**	NO

Note (1)

kV check and eventual adjustment is necessary.

Collimator lamp replacement

1) Remove attachment of Face shield protection by means of four fixing screws
2) Open collimator assembly by removing the four fixing screws
3) replace lamp only with original spare part having the same filament orientation.



Switch on circuit and sequence

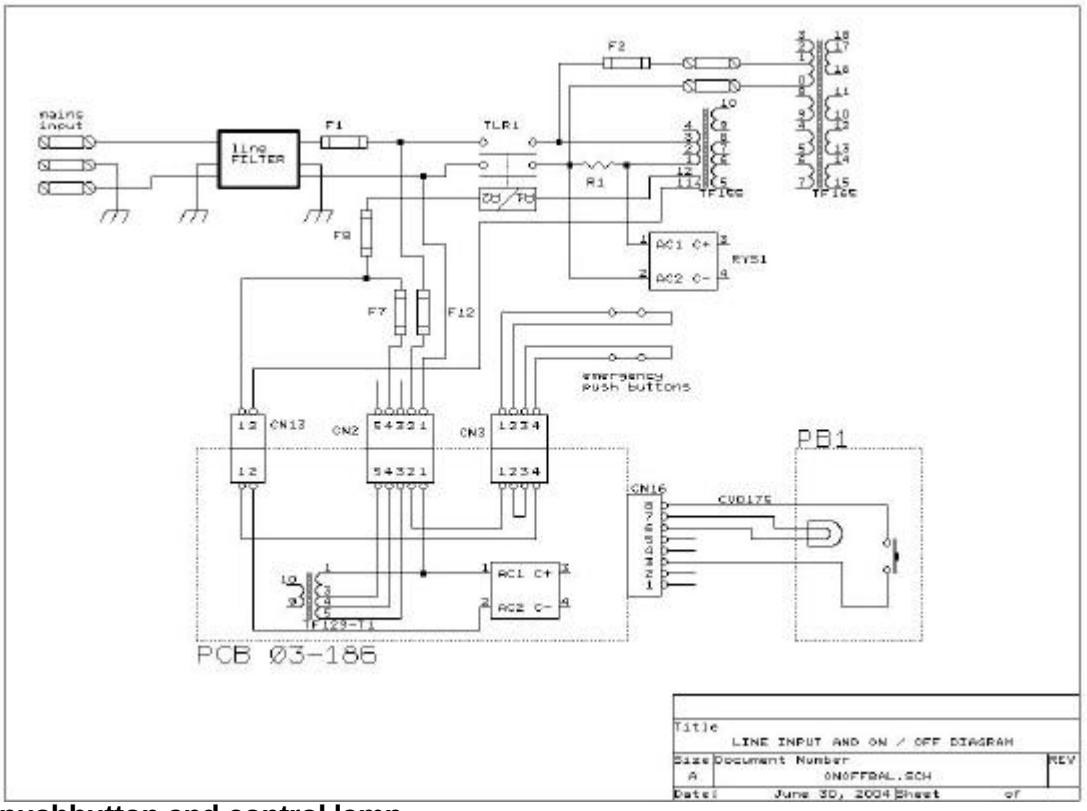
Unit is switched ON by means of main contactor TLR1 and solid state relay RYS1.
Drive and timing circuit is on board of PCB 03-186, powered by TF129.

Switch On sequence
Main contactor TLR1 switches ON at first and dumping resistor R1 smooths inrush current of TF155, TF165 and capacitors C1,C2,C3,C4.
After few seconds RYS1, with zero cross drive, shorts R1 and full power is available for H.V. generator and other high power services.

Display and Keyboard initialization
Keyboard (PCB 92-083+03-181) has its own dedicated CPU.
At power ON, empty frame is drawn by keyboard CPU on the display.
When main CPU of PCB 01-170 starts, display frame is filled with icons.

Grid position initialization
At power ON grid is moved to search home position and noise from the table is normal.
Grid home position is at left side from patient position.

Emergency shutdown
Emergency push buttons located on both sides of MAMMOMAT Balance.
Operating Emergency push button will switch OFF immediately main contactor TLR1 and the whole unit is switched OFF.



ON/OFF pushbutton and control lamp
Connected to CN16 of PCB 03-186 has control lamp inside.
Control lamp is bright when unit is OFF, after switch OFF, lamp blinks for a short time during which further switch ON is disabled to allow high power circuit to reset.

Table detection and grid test

Table driver

Table driver is onboard of PCB 03-188 motherboard, it contains both cassette sensing + leds for all tables and stepper motor driver for grid tables.
Table driver is connected by serial port to main CPU.

Table detection

The following tables are detected by the CPU in order to guarantee the appropriate functionality.

Model	Part number
18x24 gridless	83.83.189
18x24 grid	83.83.171
24x30 gridless	83.83.239
24x30 grid	83.83.221
18x24 gridless 1,8 X magnification device	83.83.353

Cassette detection functions are the same for all the tables.
Green LED is bright fix when unexposed cassette is in. Unit could not be ready for exposure depending on Door Open and/or no collimation plate.
Green LED is blinking for all other conditions.
If cassette notch sensing switch is enabled (Table internal jumper removed) and cassette has no notch, green Led is blinking even if cassette is properly inserted.

Grid tables.
If grid table is recognized, x-ray beam is pulsed. Both large and small focus can be selected from the control panel.

Gridless tables.
If gridless table, any kind, is recognized, x-ray beam is continuous, small focus is selected automatically and deselected when gridless table is removed.

Grid movement test

If grid table is inserted, by means of pushbuttons Bell + Compression [-] grid can be moved without exposure for functionality check.
Grid must oscillate back and forth.
Grid speed is different during the first 7 runs for strokes First right / left, speed for movement must be regular
Grid movement has time-out of 20” to protect stepper motor.
When Grid movement is activated by main CPU, DL8 of PCB 03-188 becomes bright fix and .LED2 PCB 01-170 blinks following x-ray interruption at grid direction change.
Grid home position is at left side from patient position.

Troubleshooting

- o If unit doesn't switch ON refer to dedicated section of this manual.
- o If unit can be switched ON but: no Frame and no Icons appear on the screen and CPU reset sequence is wrong , check voltages on CPU motherboard 03-188
- o If unit can be switched ON but: Frame and no Icons appear on the screen and CPU reset sequence is wrong , check CPU 01-170.
- o If unit can be switched ON but: no Frame and no Icons appear on the screen and CPU reset sequence is correct check keyboard 92-083, KEYBOARD CPU 03-181, cable CV0155 and supply voltages onboard of KEYBOARD 92-083

If the unit is operative fault finding and troubleshooting is based on the followings:

1) Operating or technical errors on display
2) Technical menu
3) Technical errors in Log file

1) Operating errors on Display

Operating errors on Display are described in the Operator's manual SPB7-115.620.01….
For the technical aspects related to such alarms:

ALARM	**GAS SPRING DEFECTIVE !**
Code	**Gs**
When	Any time when unit is ON
Why	Gas spring has loosed it's capacity to balance c-arm suspended masses
Action	For Gas Spring replacement refer to "Gas spring replacement" section in this document

WARNING	**For safety reasons unit can't be operated if Gas Spring is defective. Alarm can't be cleared**

ALARM	CHECK ARM PUSH BUTTON CHECK BRAKE PUSH BUTTONS CHECK FOOT PEDAL SWITCH
Code	Pa Pb Pc
When	during operating of compression or c-arm rotation or c-arm vertical movement or anytime for eventual malfunction of pushbuttons or foot pedal switches .
Why	pushbutton or foot pedal switch of mentioned functions remains activated for more than 20”
Action	Check pushbuttons or foot pedal switches and eventually disconnect them from the boards for easier investigation.
Note	Alarm goes OFF by itself if normal condition is restored releasing pushbutton or foot pedal switch.

ALARM	CHECK CASSETTE
Code	Ci
When	At power ON
Why	Cassette was inside the table and could be exposed.
Action	Remove cassette check it and reinsert. If alarm comes out without cassette inside check cassette sensing microswitches.
Note	Alarm goes OFF by itself if normal condition is restored removing cassette

ALARM	DOOR OPEN
Code	Do
When	Starting exposure
Why	Door of Examination room was open when operator pressed x-ray push button
Action	Close door or check door contact and / or wiring to PCB 03-186.
Note	Alarm goes OFF by itself if normal condition is restored closing the door. Exposure is not interrupted if door is open after that exposure sequence started.

ALARM	ABSENCE OF COLLIMATOR CONE
Code	C0
When	Starting exposure
Why	Collimation plate is missing
Action	Insert collimation plate or check sensing microswitch and / or PCB 02-179 and connection cable to main CPU CV0158
Note	Alarm goes OFF by itself if collimation plate is inserted

ALARM	CASSETTE NOT INSERTED CASSETTE ALREADY EXPOSED
Code	Nc Ce
When	Starting exposure
Why	Cassette is not inserted or already exposed or cassette sensing switches are defective
Action	Insert or replace cassette or check cassette sensing switches
Note	Alarm goes OFF by itself if cassette is inserted or removed.

ALARM	MIRROR POSITION ERROR
Code	Me
When	Starting exposure
Why	Mirror is not out of field
Action	Check if mirror doesn't move totally or partially for mechanical or electrical problems. Mirror drive motor has position sensing switch inside that must switch (audible click) when is at 60 degrees with respect to the base plate. Mirror driver is onboard of PCB 02179 connected to the main CPU by CV0158.

ALARM	FILTER POSITION ERROR
Code	Fi
When	Filter changes from Mo to Rh or vice-versa
Why	Position sensing switch is not closed
Action	Select manual mode, select filters several time to investigate if it's mechanical or electric problem. Filter is driven by PCB 02-179.

ALARM	NOT ACTIVE
Code	T0
When	Starting exposure in automatic mode
Why	Film Screen or technique STD, EXT, LD, HC selected on the control panel is not programmed.
Action	Select programmed Film Screen and technique STD, EXT, LD, HC. If only one is programmed, freeze it by means of DIP5 SW1 PCB 01-170. If problem persist it's probably due to memory corruption, transfer again AEC calibration curve to CPU memory

ALARM	EARLY PUSHBUTTON RELEASE
Code	Rp
When	During exposure
Why	Pushbutton has been released before the end of exposure Pushbutton is defective
Action	Inspect pushbutton at sight, select high mAs value and during exposure force: cable, connector and pushbutton to locate possible false contact. Replace pushbutton.
Note	Display shows exposure mAs and kV

ALARM	LOW ANODE CURRENT
Code	Bt
When	After exposure in MANUAL mode
Why	Anode current was below lower limit or zero. Exposure has been terminated by Back Up Timer.
Action	Check anode current calibration according to specific section of this manual. Also check kV value according to specific section of this manual. Alarm can also depend on malfunction of V/F converter onboard of PCB 92-073, event counter on board of PCB 01-170 and cable CV0173. To investigate mAs integrator, check LED5 PCB 92-073 and LED3 PCB 01-170 For further investigation, external Dose meter or radiographic cassette with film can be used to detect if x-ray are generated or not. LOW ANODE CURRENT could also be due to H.V. generator defect or failure, check it as described in dedicated section of this manual.

ALARM	AEC DETECTOR OVER EXPOSED
Code	A1
When	After pre exposure
Why	Breast and / or detector position is/ are wrong, part of detector was exposed to direct x-ray beam. Breast or phantom density was too low.
Action	Check for proper breast / detector positioning or thin phantom.
Note	Film must be replaced. Delivered mAs are less than 1 mAs

ALARM	BREAST TOO DENSE
Code	A0
When	After pre exposure
Why	Breast density is too high and [p] value lower than limit selected during AEC calibration Breast could have silicone prosthesis. Refer to AEC calibration procedure for [p] lower limit calibration.
Action	Reduce breast density and check for AEC calibration with reference phantom.
Note	Film must be replaced. Delivered mAs are less than 1 mAs

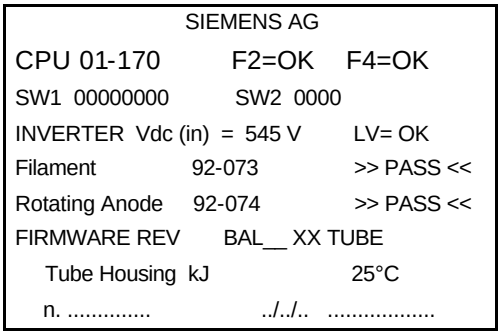
ALARM	LOW mAs SELECTION WITH AEC
Code	Mi
When	After exposure
Why	Could happen with magnification and small focus if grid table is used and breast is large or very dense. Can also happen for calibration problems or system malfunction.
Action	Evaluate operating conditions and eventually use One point mode with higher kV.
Note	Quite impossible with large focus, if happens check very carefully mA, kV, [r] and [o] calibrations.

ALARM	TUBE THERMAL LIMIT REACHED
Code	HU
When	Starting exposure
Why	X-ray tube assembly has reached maximum operating temperature.
Action	Wait for tube cooling. Evaluate operating conditions from last 1300 exposure memory. Check tube temperature sensor PCB 02-171. Disable tube rotation brake.

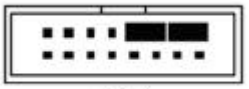
ALARM	TECHNICAL ERROR
Code	Refer to list
When	Any time.
Why	Internal error having no meaning for the operator.
Action	Check Log File to find out what it is. Date and time of error / fault can be helpful to locate it quickly

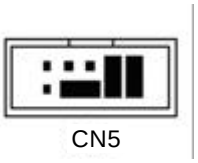
2) Technical menu

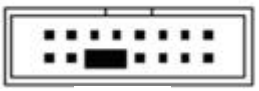
When	Any time.
Why	Broken Fuse or defective block has been located by CPU diagnostic functions
Action	Check Log File to find out when it occurred



Fault	CPU fuses F2 or F4
Action	Replace fuse

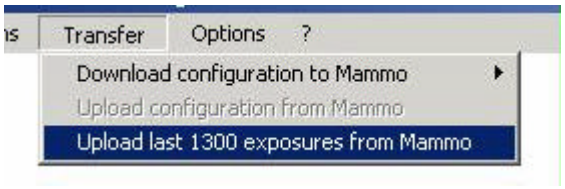
Fault	Filament 92-073 >> FAIL <<
Action	1) check LED status of PCB 92-073 2) if problem persists after having switched the Unit off and on again, verify the integrity of fuses F1 F2 PCB 92-073 and of filaments by an ohmmeter. 3) if Alarm Code is T2 it was generated during preparation, check for eventual corruption of filament calibration values Check also calibration of Over-current and Over-voltage protection circuits. 4) if Alarm Code is R2 it was generated during exposure check calibration of Over-current and Over-voltage protection circuits. 5) if in doubt that filament board safety circuits are not recognized by CPU, they can be simulated by means of jumpers on the flat cable CV0173.  CN2

Fault	Rotating anode 92-074 >> FAIL <<
Action	1) check LED status of PCB 92-074 2) if problem occurs when the unit is in stand by check that flat cable CV174 connecting PCB 92-074 and PCB 01-170 has been correctly seated. Also check fuses F1 and F3 of PCB 92-074 3) if problem occurs in preparation error code is T1 check for line voltage, protection circuit calibration of PCB 92-074, voltage across shift capacitors C5 and C6 that typically is about 120 Vac (50hz) during anode running. If voltage is lower shift capacitor is probably defective. For capacitor voltage check, protection circuit has to be disabled. 4) if problem occurs during exposure, error code is R1 check the same as above point 3 5) alarm can also occur due to tube overheating when internal thermo switch opens. 6) if in doubt that starter board safety circuits are not recognized by CPU, they can be simulated by means of jumpers on CN5 PCB 01-170 or flat cable CV0174.  CN5

Fault	INVERTER
Action	1) if problem is LV=NOK and LED DL1 is Dark replace F2 2) if problem is LV=NOK and LED DL1 is Bright check flat cable CV0172 end eventually simulate inverter block by means of Jumpers on CN3 PCB 01-170  CN3 3) If technical menu appears with Vdc (in)= 000 then F3 of PCB 94-132 is broken, inverter block **08883436** and H.V. transformer **08883444** must be replaced. 4) If technical menu appears with Vdc (in) = **270 V** F6 or F9 is broken. For investigation of INVERTER Vdc problems, sensing circuit and alarm can be disabled by means of DIP2 SW2 PCB 01-170. Vdc voltage sensing is connected at CN4 PCB 94-132 and CN9 PCB 03-188, connection cable is CV0164. Normal voltage across CN9 with cable CV0164 connected is about 19,5Vdc. Voltage across CN4 PCB 94-132 is about 47 Vdc with CV0164 disconnected Vdc (in) drop is about 100Vdc during exposure and ripple in the same condition is typically 50 Vpp. If Vdc drop and ripple voltage are much higher capacitors C1,C2,C3,C4 must be replaced
Note	For kV problems refer to High Voltage generator section in this manual

3) Technical errors in LOG file

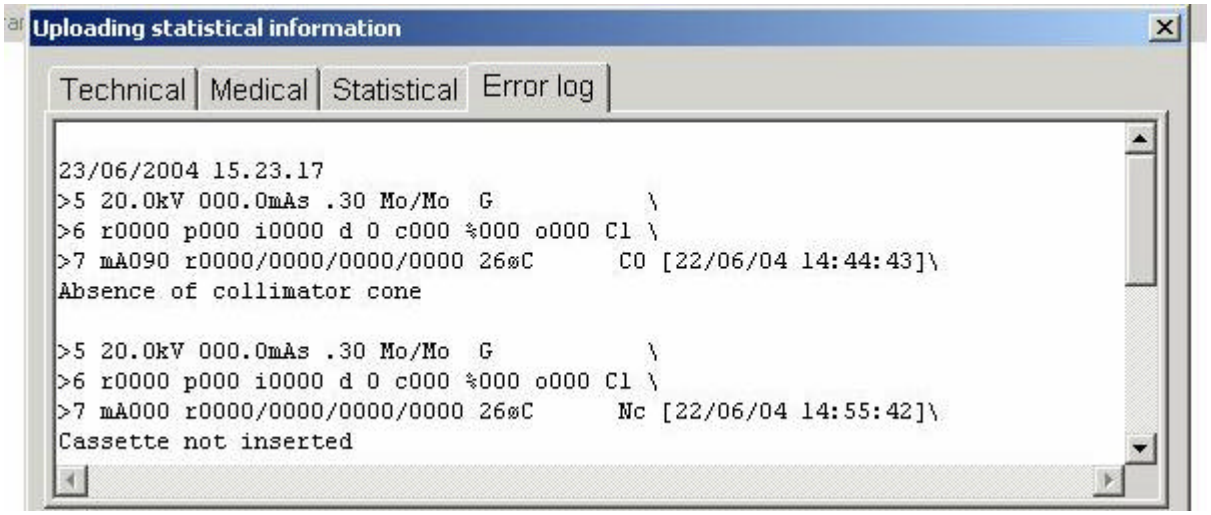
CPU of MAMMOMAT Balance has a memory with the last 1300 events including errors and fault events. This 1300 events can be uploaded on the PC.



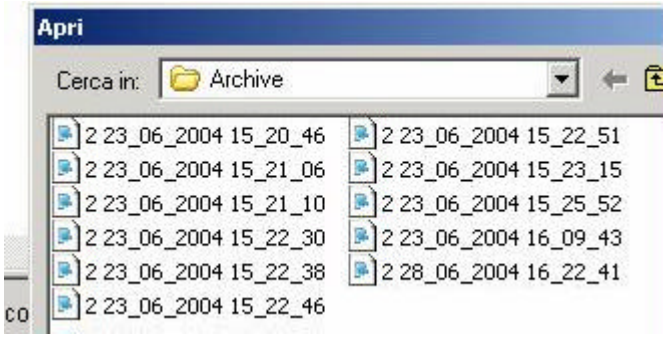
Choose Error log,

insert a comment, press Start and press the two buttons Alarm reset and Optical density plus on the mammo contemporarily.

Now you can see, on the “Uploading statistical info” window, the data being uploaded. When the mammo finishes to transmit data, it emits three quick tones to advise you. If you want to stop the transmission push the two buttons Alarm reset and Optical density minus contemporarily. If you want to delete all the 1300 events in the mammo, press the three buttons alarm reset, optical density plus and optical density minus contemporarily.
DEATA Plus software creates a LOG file that can be opened clicking on View Stat button.



Log file contains string with error code and full description in the last line
Error log file can be selected between all those available, identified by time and date of Upload



Memory string

The following string is an example of data available for each exposure or fault.

```
-------------------------------------------------------------
>5 26.5kV 126.6mAs .30 Mo/Mos G 0P 27.2mGy\
>6 r0110 p076 i0472 d 0 c100 %100 o011 C1 \
>7 kS206 r0110/0110/0110/0110 38°C      Af [12/03/03 15:20:02]\
-------------------------------------------------------------
```

It’s referred to exposure in Zero Point mode with code Af (no error in automatic mode)

List of Error codes

A full list of error codes is given below::

Exposure terminated without problems.	
CODE	**Description**
Af	EXPOSURE TERMINATED BY FILM AEC
Ms	EXPOSURE TERMINATED BY mAs INTEGRATOR

Exposure terminated with problems.	
CODE	**Fault description**
Rp	EARLY PUSH BUTTON RELEASE
Mi	LOW mAs SELECTION WITH AEC
Bt	EXPOSURE TERMINATED BY BACK UP TIMER
T1	ANODE STARTER FAILED DURING PREPARATION
T2	FILAMENT FAILED DURING PREPARATION
R1	ANODE STARTER FAILED DURING EXPOSURE
R2	FILAMENT FAILED DURING EXPOSURE

Operating or system errors with sample pulse x-ray emission only	
CODE	**Fault description**
A0	BREAST TOO DENSE
A1	AEC DETECTOR OVER EXPOSED

Operating errors without x-ray emission	
CODE	**Fault description**
D0	DOOR OPEN
C0	ABSENCE OF COLLIMATOR CONE
Nc	CASSETTE NOT INSERTED
Ci	CASSETTE IN AT POWER ON
Ce	CASSETTE ALREADY EXPOSED
T0	NOT ACTIVE

System errors and or faults	
CODE	**Fault description**
Gs	GAS SPRING DEFECTIVE
Pb	CHECK BRAKE PUSH BUTTONS
Pa	CHECK ARM PUSH BUTTON
Pc	CHECK FOOT PEDAL SWITCH
Fi	FILTER POSITION ERROR
Me	MIRROR POSITION ERROR
Pi	BRAKE POSITION SWITCHES MW5 , MW6 FAILURE
Mt	BRAKE MOTOR MT3 FAILURE
HU	TUBE TERMAL LIMIT REACHED

FUSES and blocks (multiple fault are shown as code addition)	
CODE	**Fault description**
80	INVERTER CONTROL BOARD
40	FILAMENT POWER SUPPLY
20	ROTATING ANODE STARTER
10	INVERTER POWER
08	F4 PCB 92-082
04	F2 + 15P PCB 92-082
02	F2 + 15° PCB 92-082
01	ANODE NOT ROTATING

Rotating anode starter

Calibration of protection circuit

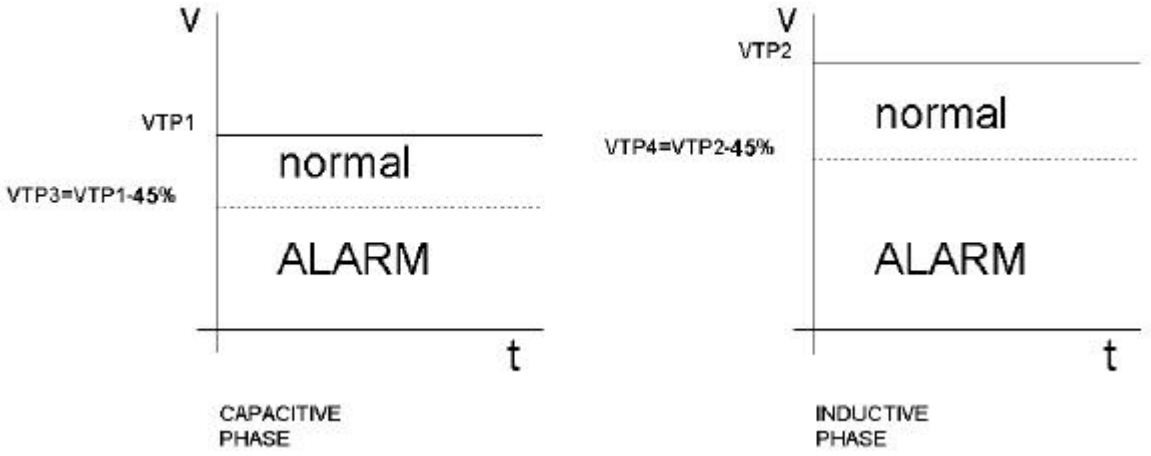
- General information

Protection circuit calibration is necessary if PCB, shift capacitors or tube is/are replaced.
Calibration is also necessary if unit is operated at 60hz line frequency.

For circuit calibration select: DEMO mode by means of DIP 3 SW1 PCB 01-170 = ON, Manual mode, 200mAs or more, remove table.
Only if necessary, disable protection circuit shorting JP4.
DEMO mode is selected to avoid x-ray emission and tube anode loading.
High mAs value is selected to have stable voltage readings at Test points TP1, TP2, TP3, TP4.

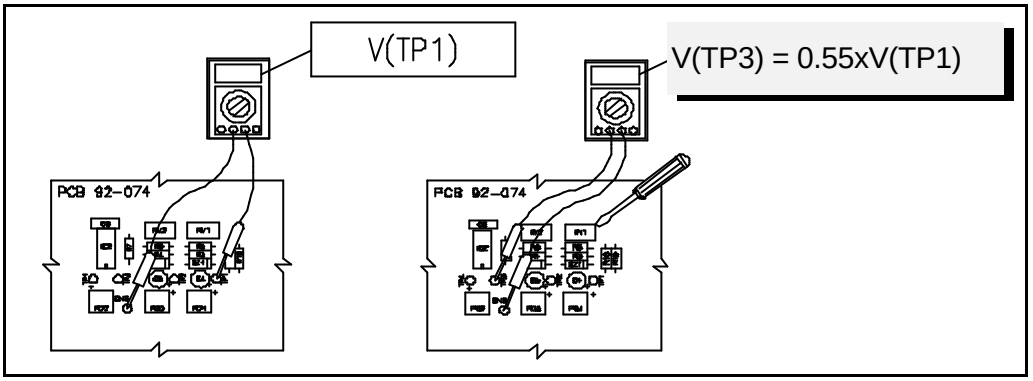
CAUTION	**Use only isolated tools**

Anode starter PCB 92-074 has two independent protection circuits for direct and shifted phase.
Voltage at TP1 represents Direct phase current and voltage at TP3 represents minimum reference level, normal operating conditions is with VTP1 > VTP3.
Voltage at TP2 represents Shifted phase current and voltage at TP4 represents minimum reference level, normal operating conditions is with VTP2 > VTP4.
Voltage at TP1 and TP2 is present only during tube rotation.
Voltage at TP3 and TP4 is fix and can be adjusted by means of RV1 and RV2 .
All voltages are measured with respect to GND Test point of PCB 92-074 **during tube running** not boost.

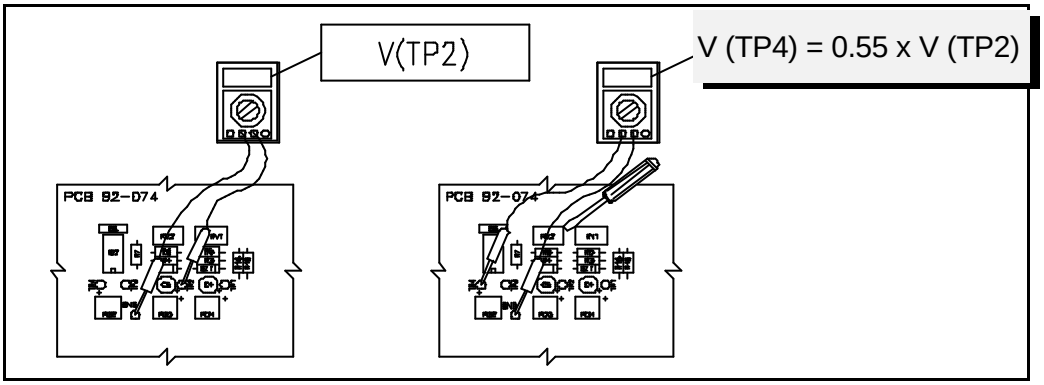


- Calibration

During tube running measure Vdc between TP1 and GND (ground) , then adjust RV1 to have Vdc at TP3 = 55% of Vdc at TP1.



Repeat same operation with **TP2**, **RV2** and **TP4.**

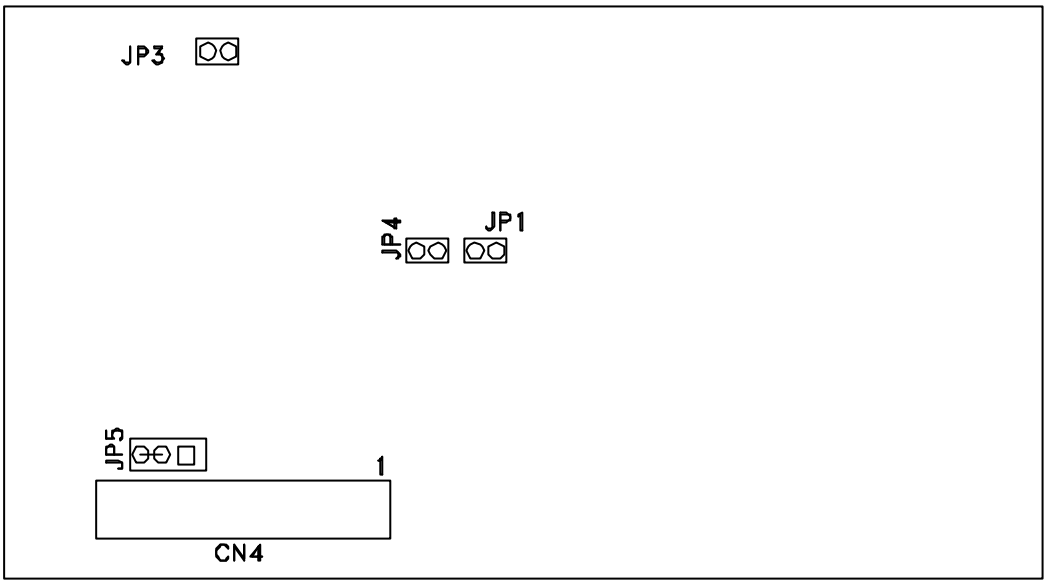


Typical values of running voltages at **TP1** and **TP2** for IAE tube XM12 are :

	IAE
VTP1	1.2 V
VTP2	2.5 V

Factory calibration voltages at TP1, TP2, TP3, TP4 can be found in the tube calibration report.

Function configuration



PCB 92-074-3

Default Jumper setting

JP1 = open	**Brake enabled**
JP2 = open	**not used**
JP3 = shorted	**Brake time 6”**
JP4 = open	**Protection enabled**
JP5 = refer to above image	

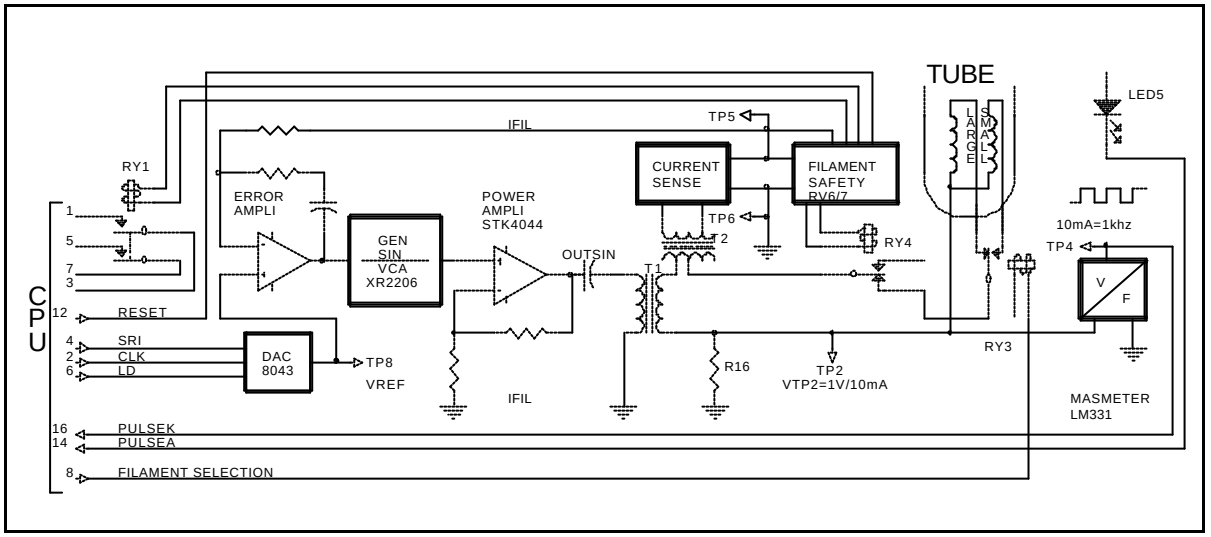
Brake disable for heavy use

Anode rotation brake is not essential for unit operation and functionality.
Brake is factory enabled, to avoid significant tube temperature increase it’s recommended to disable brake (JP1 Open) for screening or equivalent heavy duty.
Brake energy can be equivalent to Rotation start + average exposure.

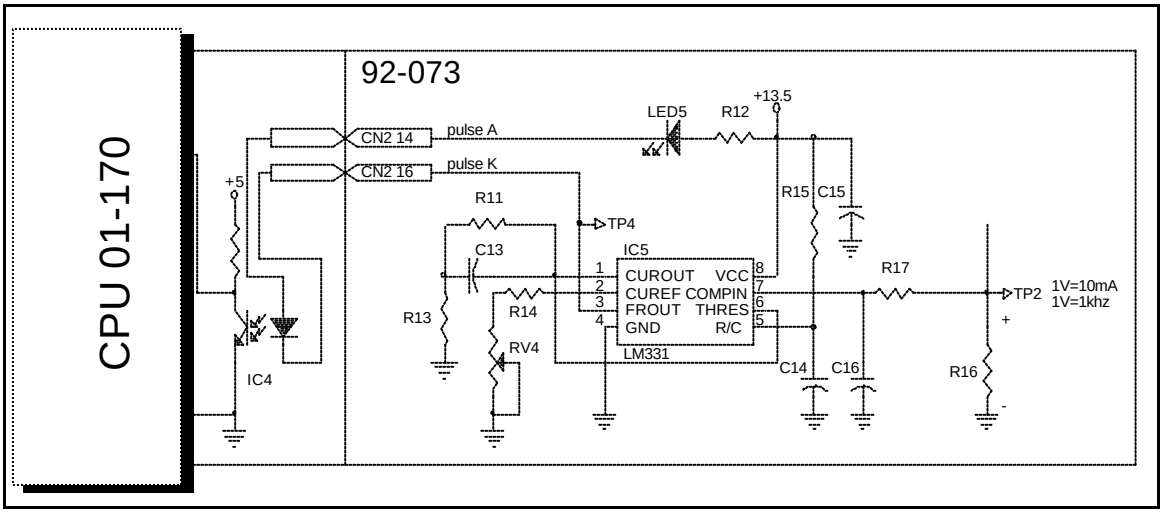
Filament

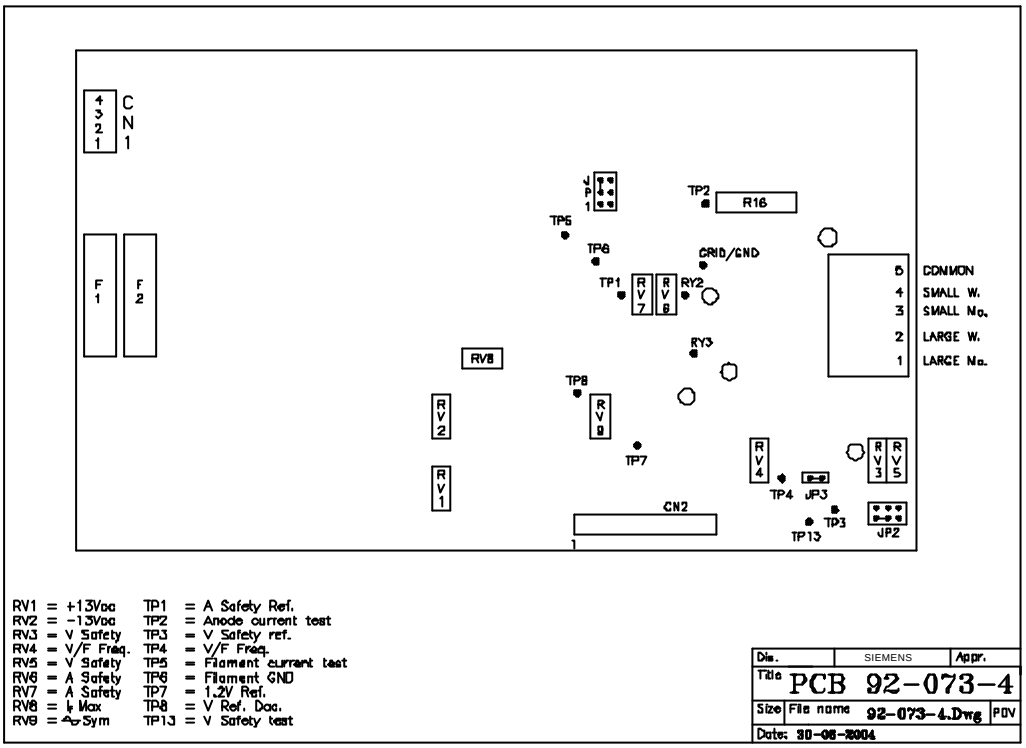
Filament power supply

X ray tube has grounded cathode and double filament (focal spot).
Tube anode current has fix stand-by current and exposure current independently adjustable for each value of kV.
Filament current is supplied by a digitally programmable sine wave current generator.
Filament is protected by over-current and over-voltage protection circuits.



On board I/f converter is connected to the CPU 01-170 digital mAs integrator for a very high resolution mAs integration.




CN1
4
3
2
1
F1
F2
JP1
TP2
R16
TP5
TP6
GRID/GND
TP1
RV7
RV6
RY2
RY3
RV8
TP8
RV2
RV9
RV1
TP7
RV4
RV3
RV5
TP4
JP3
TP3
TP13
JP2
CN2
5 COMMON
4 SMALL W.
3 SMALL No.
2 LARGE W.
1 LARGE No.
RV1 = +13Vac TP1 = A Safety Ref.
RV2 = -13Vac TP2 = Anode current test
RV3 = V Safety TP3 = V Safety ref.
RV4 = V/F Freq. TP4 = V/F Freq.
RV5 = V Safety TP5 = Filament current test
RV6 = A Safety TP6 = Filament GND
RV7 = A Safety TP7 = 1.2V Ref.
RV8 = I Max TP8 = V Ref. Dac.
RV9 = Sym TP13 = V Safety test
Dim. SIEMENS Appr.
Title PCB 92-073-4
Size File name 92-073-4.Dwg PDV
Date: 30-08-2004

Anode current calibration

- General information

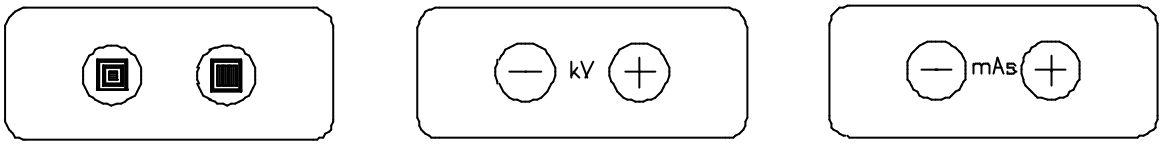
Tube anode current mA is calibrated, for each value of kV and each focal spot, by means of filament current $\mathbf{I_f}$.
Two levels of anode current **mAL** and **mAH** are defined for each focus.
mAH is related to lower part of kV range and **mAL** to higher part of kV range or mAs range.
mAL and **mAH** calibration is based on two similar but independent procedures.

- Calibration by internal instrument

Before entering any calibration mode, it's necessary to select the manual mode and a value of **mAs** equal to **40** for the **0.3 mm focus** and **13** for the **0.1 mm focus**.

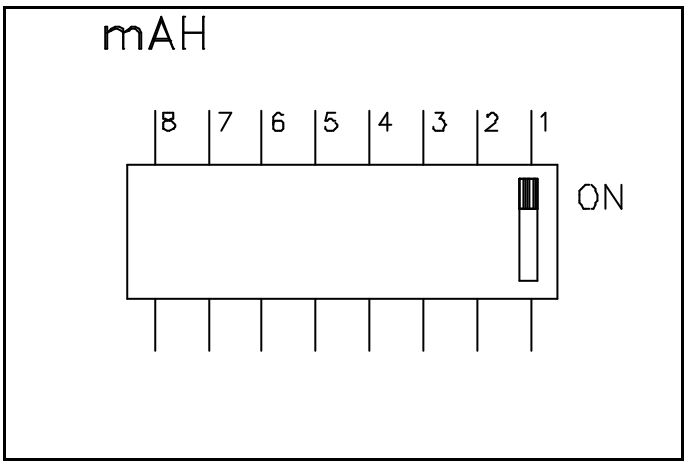
In calibration mode, the following keys are active:

- Focal spot selection
- kV selection for whole values
- filament current adjustment by mAs + / - push buttons.

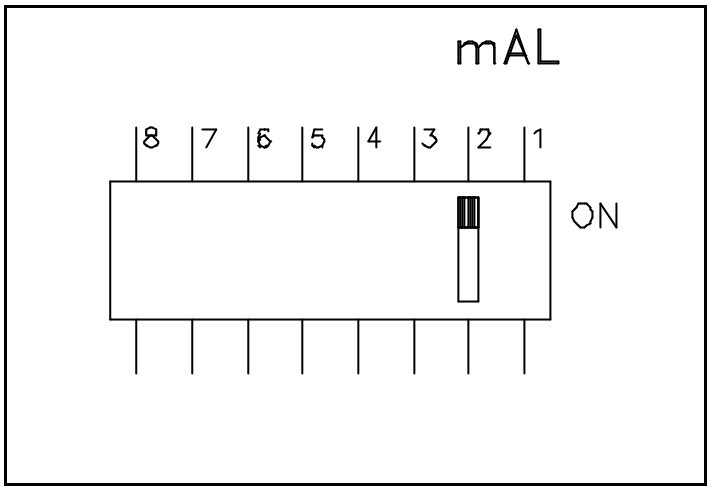


The anode current related to each value kV for each focus can be found in the Tube calibration report.

To enter **mAH** current calibration set **DIP1 of SW1** (PCB **01-170) = ON**.

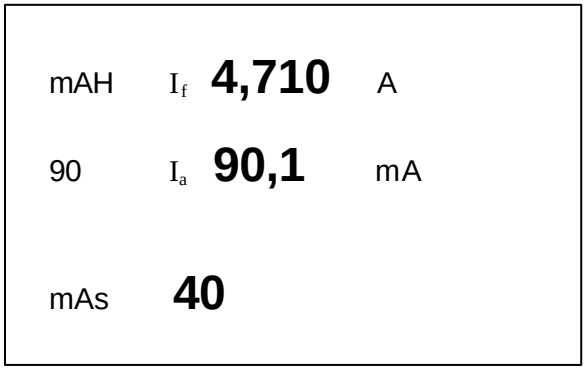


To enter **mAL** current calibration set **DIP2 of SW1** (PCB **01-170) = ON**.



In the mAs window of the display, the following parameters will appear:

- **mAH** or **mAL**, filament current $\mathbf{I_f}$ in Ampere;
- mAs value selected before entering calibration mode
- after exposure , expected anode current value and exposure $\mathbf{I_a}$ in **mA**.



After exposure the following condition can be reached:

a) Anode current less than 70% of the expected value
in place of the anode current value, on the display **LLL.L** will appear.
It means that exposure ended by means of Back-Up Timer.
Increase $\mathbf{I_f}$ **filament** current by 0.050 and repeat the exposure.
If the display indication is still **LLL.L**, repeat the above point till you get the indication of mA value and no more the **[LLL.L]**

b) Anode current higher than 10% above expected value
in place of the anode current value, on the display **HHH.H** will appear.
Decrease $\mathbf{I_f}$ filament current by 0.050 and repeat exposure.
If the display indication is still **HHH.H**, repeat the above point till you get the indication of mA and no more the **HHH.H**.

c) Anode current within normal limits

mA measured during the last exposure will appear on display.
Variations by 1 mA are obtained by changing I_f of about 0,005 A
Variations by 5 mA are obtained by changing I_f of about 0,025 A
Variations by 10 mA are obtained by changing I_f of about 0,050 A
After each filament current change, check the effect on anode current with an exposure.
Repeat the operation till you get the value of expected mA within +0 / -5%

d) Over-current and Over-voltage protection circuit intervention

If Filament current is increased for calibration with respect to previous values Over-current or Over-voltage alarm could occur.

Over-current

Check if **LED1** and **LED4** switch OFF after pushing x-ray pushbutton.
In such a circumstance, increase voltage reference at **TP1** by means of **RV6**

Over-voltage

Check if **LED1** and **LED4** switch OFF after pushing x-ray push button.
In such circumstance increase voltage reference at **TP3** by means of **RV3**

When calibration is finished protection circuits MUST be recalibrated

Calibration of filament current protection

After anode current calibration, maximum filament current at 20kV is known.
Maximum current level is calibrated by means of RV6 for the 0.1 mm small focus of IAE XM12 tube
The reference level for current limit is defined at 10% above the maximum filament current for each focus.

Step by step calibration:

a) connect a voltmeter 10 Vdc f.s. on **TP6**(GND) and **TP5**.
b) select **SMALL FOCAL SPOT**
c) select 20kV
d) measure voltage on **TP5/TP6** during preparation
e) connect a voltmeter 10 Vdc f.s. on **TP1** and **TP6**(GND).
f) adjust **RV6** till reaching a value equal to voltage measured at point (d) increased by **+10%**

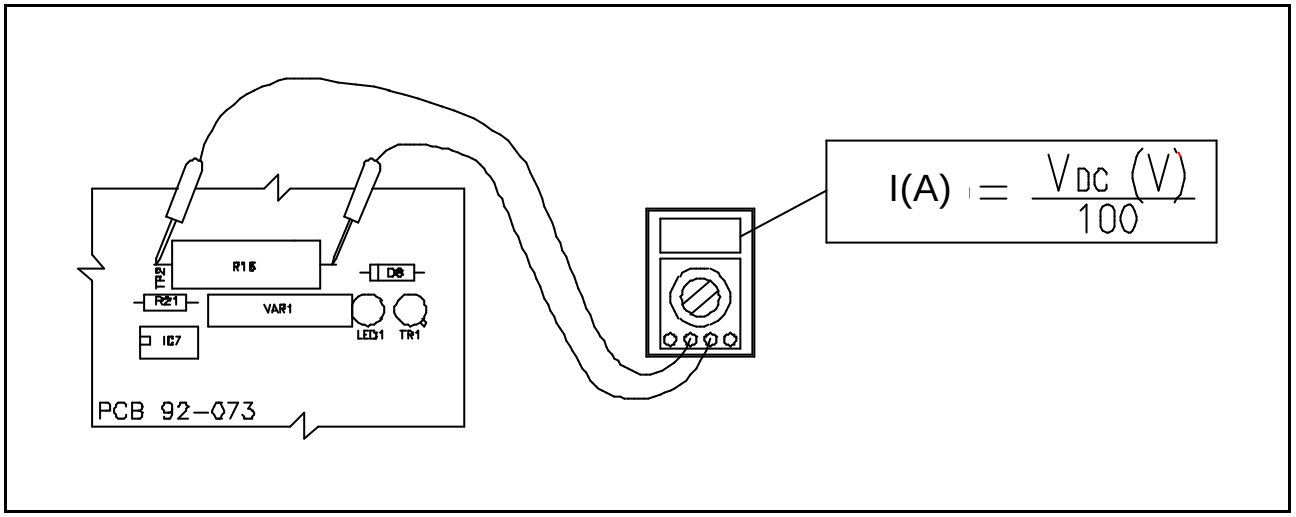
Calibration of filament voltage protection

Step by step procedure:

a) verify that JP3 bridge is closed
b) connect a voltmeter 10 Vdc f.s. on **TP6** (GND) and **TP13**.
c) select **LARGE FOCAL SPOT**
d) select 20 kV
e) measure voltage on **TP13/TP6** during preparation
f) connect a voltmeter 10 Vdc f.s. on **TP3** and **TP6** (GND).
g) adjust **RV3** till reaching a value equal to voltage measured on **TP13/TP6** at above point (e) **+10%**

Anode current check by external device

Anode current check can be carried out using a voltmeter or an oscilloscope connected to resistor R16 of PCB 92-073.
Measurement is executed during an exposure of a minimum time consistent with reading time of device used.
In case of use of a digital voltmeter >1" and consequently 100 ÷ 130 mAs per large focal spot and 32 mAs per small focal spot.
DO NOT USE DIGITAL VOLTMETERS IN AUTORANGING MODE AS THEY NEED READING TIMES LONGER THAN 1".
In case of use of a memory oscilloscope values suggested are the same for internal mA meter (40 mAs for the 0.3 mm focus, 13 mAs for the 0.1 mm focus).

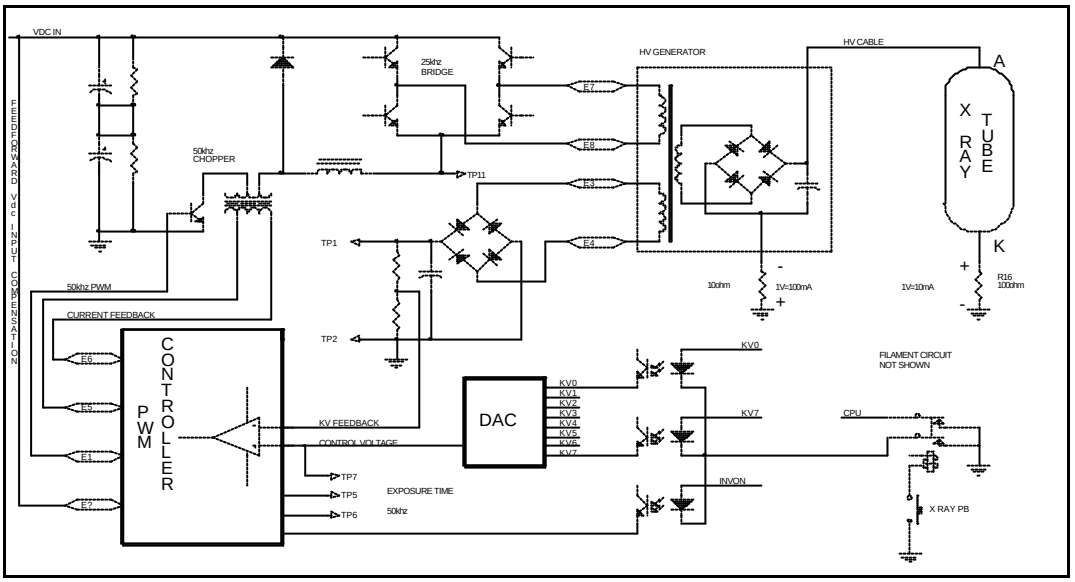


WARNING **do not calibrate kV values not mentioned in the table.**

High Voltage generator

Description

High Voltage generator has positive polarity with respect to ground to supply X-ray tube with grounded cathode.



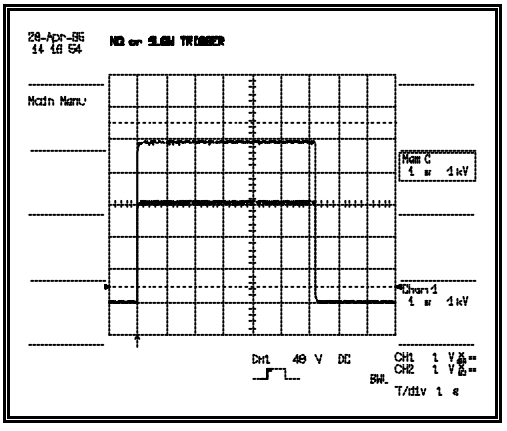
High voltage is set by the CPU through an 8-bit opto-coupled bus IC6/IC7/IC8.
Ground return of opto-couplers is directly connected to x-ray pushbutton by means of dead man function for maximum continuous safety.

NOTICE Releasing x-ray pushbutton high voltage and x-ray emission stops immediately.

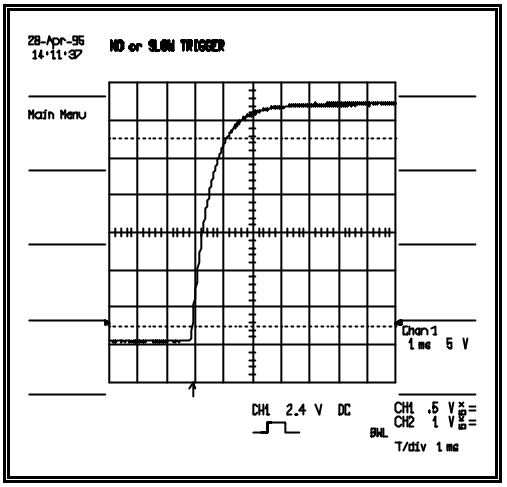
Output bridge is supplied by PWM power supply with current limit capability.

NOTICE Anode current overload results in kV output limitation.

If not overloaded, kV output is independent of anode loading and overshoot free.



kV waveform at 20 kV and 35 kV measured on TP1



kV risetime is typically 1.5 ms in any load condition

Non invasive kV check

kV measurement with non-invasive instruments is affected by beam filtration and MUST be done exclusively with MOLYBDENUM filter and without compression plate between x-ray source and kVp meter.
kVp meter calibration factors, non linearity and filter thickness must be taken into consideration to correct measured values.

kV check at TP1/TP2 PCB 94-132

H.V. generator has voltage divider on which kV check can be done by means of normal DVM with 1000 Vdc full scale or oscilloscope with probe able to withstand a minimum of 500 Vdc.
Connect DVM or oscilloscope to TP1/TP2 (GND) of PCB 94-132.
In the table below kV vs. VTP1 are given.

kV	VTP1 (±1%)
20 kV	279 Vdc
21 kV	293 Vdc
22 kV	307 Vdc
23 kV	320 Vdc
24 kV	334 Vdc
25 kV	348 Vdc
26 kV	362 Vdc
27 kV	376 Vdc
28 kV	390 Vdc
29 kV	404 Vdc
30 kV	418 Vdc
31 kV	432 Vdc
32 kV	446 Vdc
33 kV	460 Vdc
34 kV	474 Vdc
35 kV	488 Vdc

NOTE

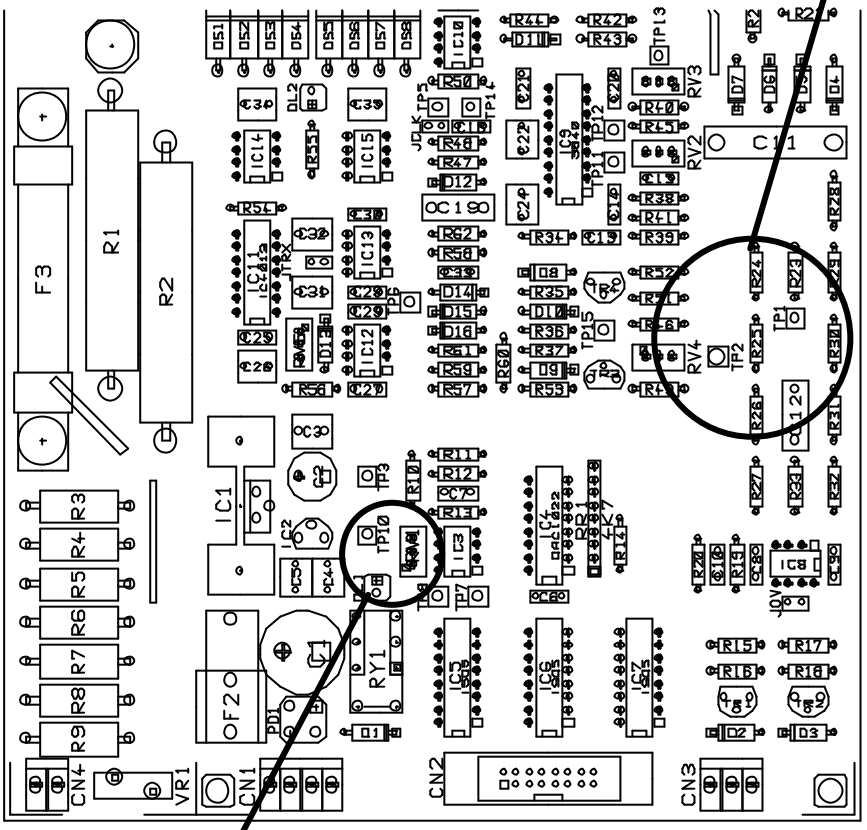
1) kV vs. VTP1 values are only valid if reference voltage measured on TP8 is 5.00 Vdc (standard calibration). If not, new VTP1 can be calculated wth the following formula: VTP1(new) = (VTP1(table)/5.00) * VTP8
2) If necessary kV values can be corrected by means of RV5 (PCB 94-132). RV5 has influence on the whole kV range, adjust kV at 28 kV as pivot point.
3) kV values are not affected by the mains voltage within the specified limits
4) kV values are not affected by the anodic load within the normal operating range.
5) Measurement of kV value MUST be done only in MANUAL mode since in Automatic mode exposure is always preceded by pre-exposure pulse.
6) X-ray beam is pulsed to avoid grid artifact with grid table, to avoid H.V interruption use grid-less table or remove grid table or press [RESET alarm]+[kV+] buttons (valid for the next exposure only) or set DIP4 SW1 PCB 01-170 to ON for permanent interruption disable.
7) kV values are not affected by replacement of inverter block or H.V. transformer and no kV calibration is necessary if kV value has not been corrected with RV5. After repair kV check is anyway necessary.

Test points and adjustment

PCB 94-132

TP1	kV check according to conversion table
TP2	ground
TP3	ground
TP4	+5 Vdc
TP5	HIGH + 13 Vdc during exposure
TP6	reference frequency 50 kHz
TP7	kV control from CPU 1/100 VTP1 (valid in PREP and EXP)
TP8	+5.00 Vdc reference (standard calibration)
TP9	not used
TP10	internal input voltage +15 Vdc

TP1-TP2 for kV checks on (PCB 94-132)



RV1 for kV correction

AEC calibration

Refer to Start Up manual SPB7-115.815.01....
Instructions are also contained in Help Files of DEATA Plus calibration software.

Dose calculator

WARNING!

If for any reason, proper operation of Dosimeter can't be guaranteed, IT'S RECOMMENDED TO TOTALLY DISABLE it

Introduction

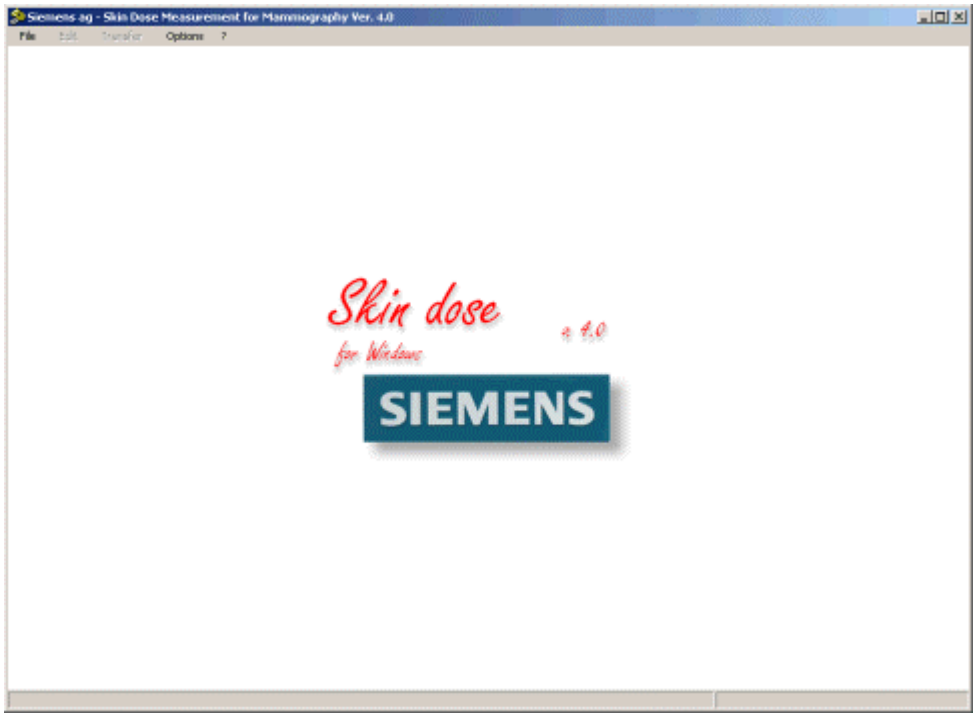
Dose calculator evaluates the skin entrance dose knowing :

1. kV of exposure
2. mAs supplied
3. distance from Focus to skin (resolution 5mm)
4. measured dose with dosemeter at a distance of 55 cm from Focus for each kV value and for each combination of anode and filter

The dose is calculated at the end of an exposure.
The obtained dose value is shown on screen. It can be printed on Film by ID printer and recorded in the unit for statistical purposes.
The Dose is visualized in mGy with a resolution of 0.01 from 0 to 9.99 mGy, and 0.1 from 10 to 99.9 mGy. Beyond a 99.9 value, HH.H will be displayed.
The ID print function on Film can be enabled or not by the user or by the Health Physicist. Calibration and periodic maintenance are based on external calibrated reference Dosimeter.

Accessing the program

Preliminary operations

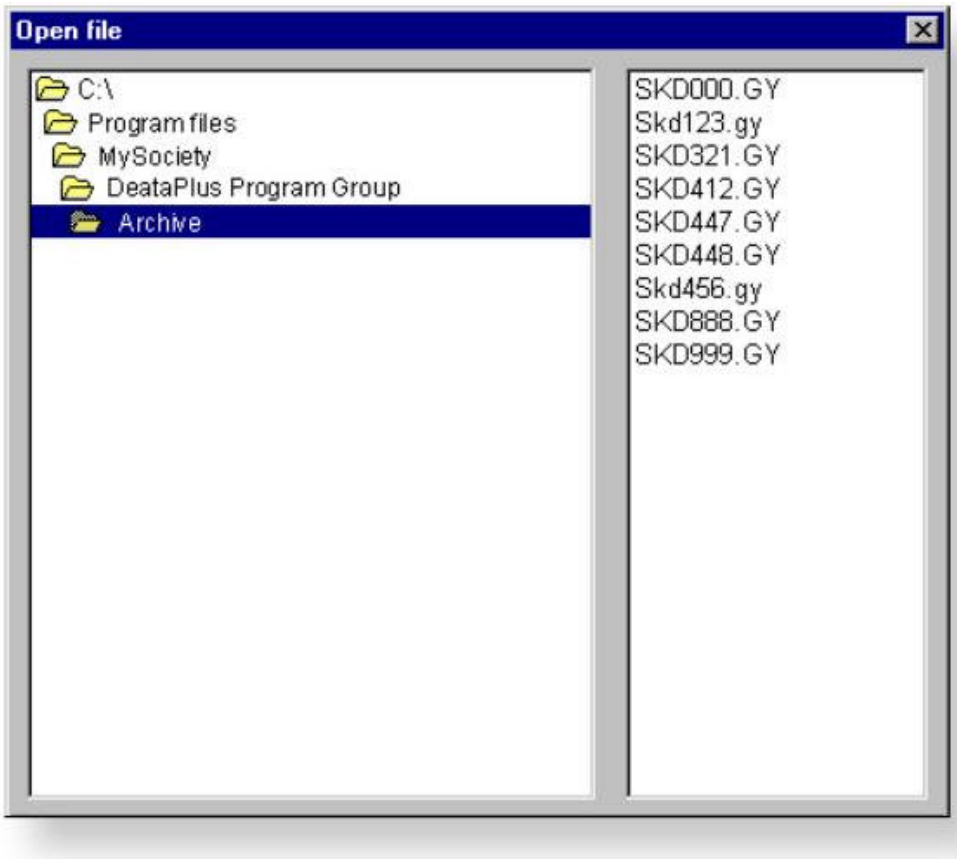


Clicking the icon of Skin Dose program in the Deata-Plus program group, the main window opens, showing the desktop for graphics and the menu for functionality of the program.

At the opening, part of main menu is disabled. This is because you must first have a configuration loaded in to view and edit data. So the only action you can perform is the loading of a particular configuration or the definition of a new one.

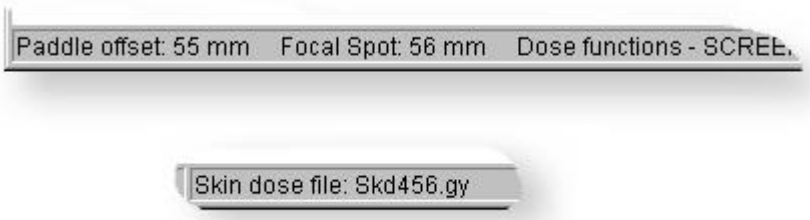
Opening a configuration file

To open a configuration file or to create a new one the "File"-"Open" menu is provided.



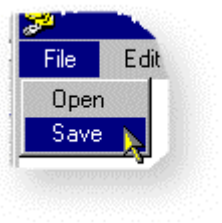
The "Open file" window opens, showing a list of available files. The directory first opened is the one stored in the Deata Plus setup file and selected with the "Option"-"Define path" menu. Anyways, you can select another doubleclicking in the filelist on the left. Double-clicking the desired configuration in the rightmost list, all the necessary files are open and loaded in the program.
In the rightmost list you will find one configuration per any mammo unit that you previously created by the Deata Plus program.

So that you don't need to create a new skin dose file for a mammo unit and you cannot delete it.
The Deata Plus program does this for you, with a default set of values at creation, and deleting the skin dose file when a mammo unit is deleted using the Deata Plus program.



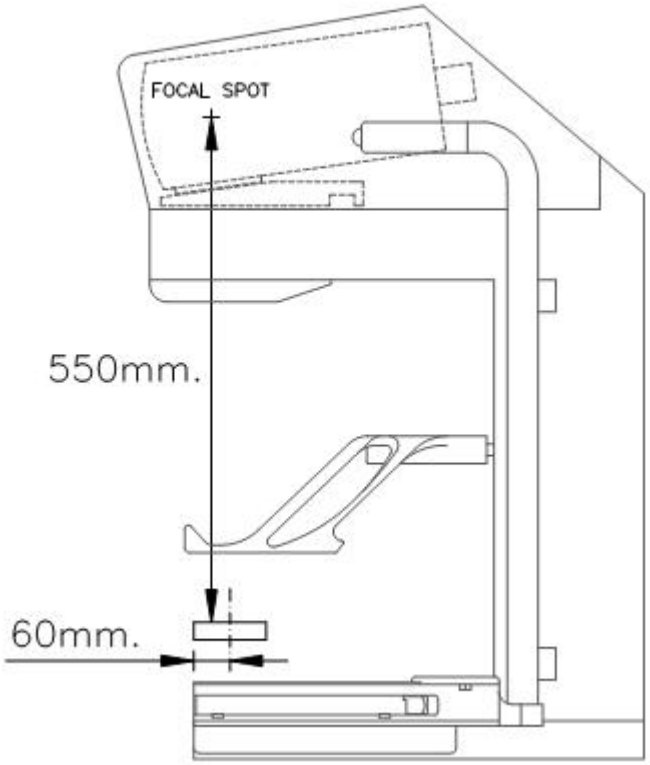
The "Open file" window closes and the main window reflects the loading of the correct configuration file showing the characteristics of the dosemeter and the name of the file.

Saving configuration file



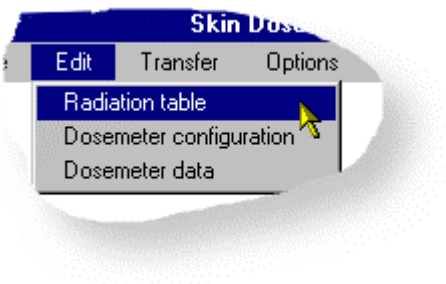
All modifications that have been made to configuration file are either immediately saved to file or retained in memory. At any point in the program you can save all this modifications, regardless partial savings occurred before. Press "File"-"Save".

System configuration for calibration



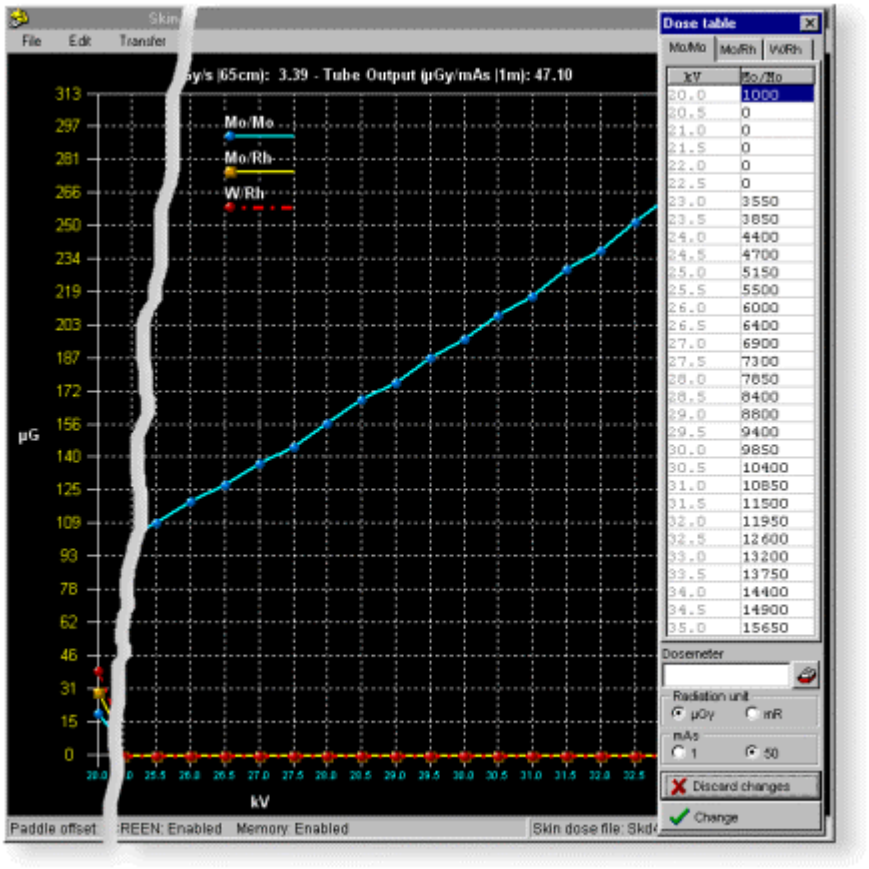
- Compression paddle must be in
- Reference dosimeter must be placed under the compression paddle
- Dosimeter reference plane must be located at 550mm from focal spot
- Characteristics, response linearization, and unit of measure of reference Dosimeter must be configured before to start calibration
- Reference dose outside kV range of reference Dosimeter must be set at ZERO

Radiation table

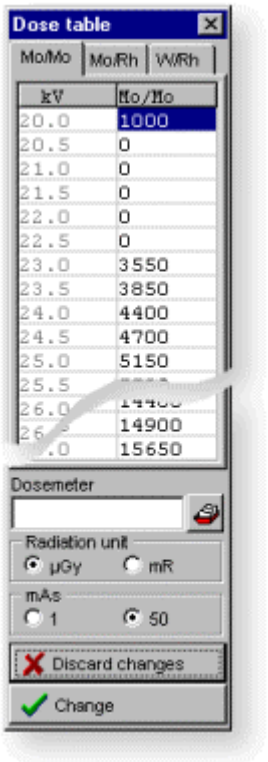


To view and edit the radiation table for the selected mammo press the "Edit"-"Radiation table" menu.

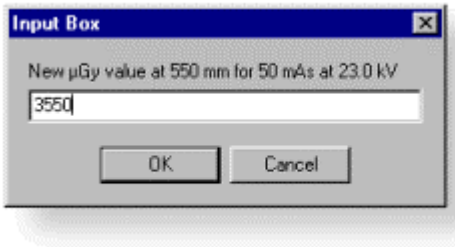
Dose calculator



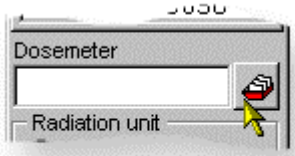
The curve is drawn on the canvas of the main window, while data are reported into a separated window, from which you can edit them. This window is always "on the top" and you can move it to discover parts of the graphic below, but if you close it, the graphic disappears too. The graphic reports three curves in different colors and symbols. The radiation curve for the Molibdenum/Molibdenum target/filter is drawn in cyan, for the Molibdenum/Rhodium target/filter is drawn in solid yellow and for the Tungsten/Rhodium target/filter in dotted red. A little legend helps identifying the curves. The title of the graph also reports the values of Dose Rate and Tube Output.



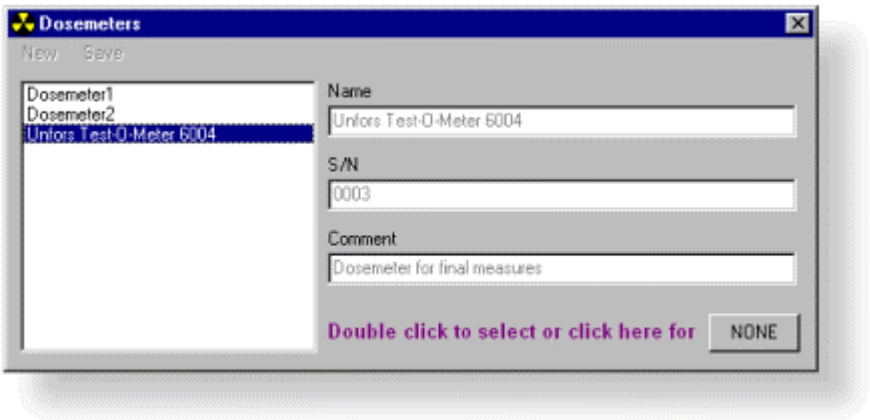
Data are presented in a "kV" versus reference dose grid. Any row correspond to a point of the curve. The kV steps are fixed, so this column is unselectable. Data are shown (and accepted) in µGy or mR, depending on the radiobutton selected in the "Radiation unit" radiogroup, and for 1mAs or 50mAs as selected in the corresponding radiogroup, while the graph is always constructed with µGy for 1mAs. To view and edit data for a target/filter combination just click on the corresponding tab. The radiation unit and mAs are separately selectable for each target/filter.



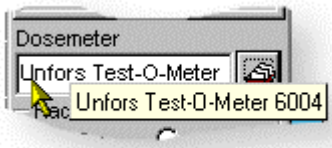
Doubleclicking a row, a "New value" dialog pops-up, indicating the radiation unit, mAs, distance and kV for which a new value is requested, and showing the actual value. Just type the desired new value and press OK. The dialog closes and the entered number overwrites the old one. The curve is redrawn, representing immediately the correction made.



You can specify the dosemeter used in measures. With this information (and related tuning parameters, see "Dosemeter data") the program can tune dose values inserted by user to obtain effective values to download to mammo.



The "Dosemeters" window opens, showing instruments found in archive (see "Dosemeter Data"). All fields are disabled. Just doubleclick the dosemeter used, or press the "None" button.

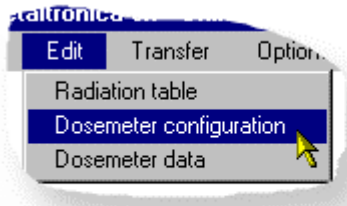


The choosen instrument name fills the corresponding edit field. You can specify a dosemeter for each target/filter combination.

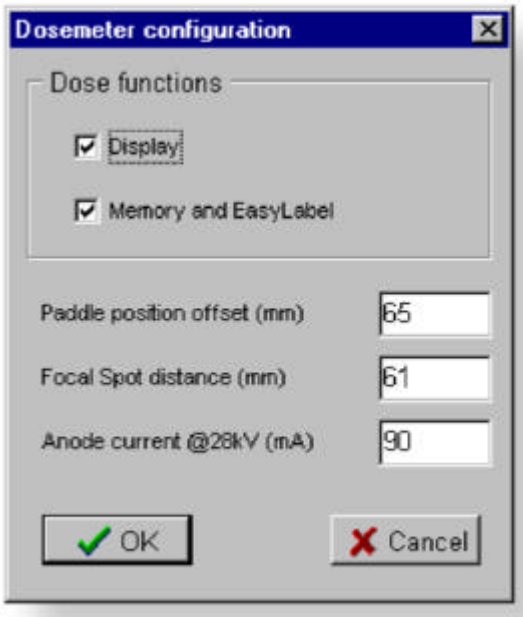
Once all changes are made, you can discard them...

...or retain in memory. **You must save changes to file to permanently store them.**

Dosemeter configuration



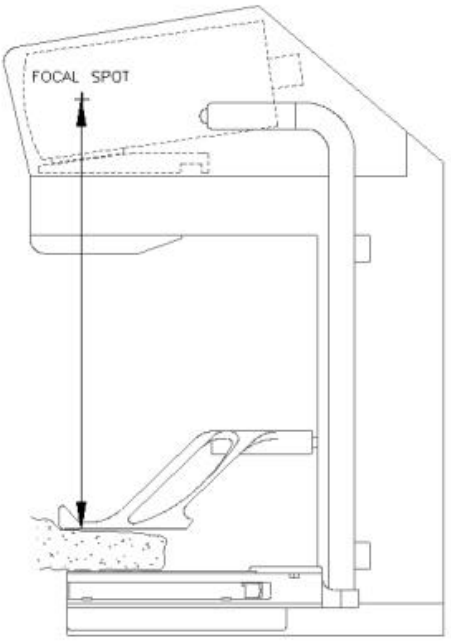
With this option you can set some operational parameters. Press the "Edit"-"Dosemeter configuration" menu.



A window opens showing the current setting for this parameters. Input desired values and press "OK" to retain changes or "Cancel" otherwise. **Remeber to "File"-"Save" modifications for permanently store them.**

DOSE FUNCTIONS
Dose shown on the LCD Display as well stored in the memory for statistic purposes and print to the ID printer can be enabled/disabled in the specific boxes.

PADDLE POSITION OFFSET
Measurement of x-ray Source to Skin distance is extremely important for a correct Skin Dose measurement.



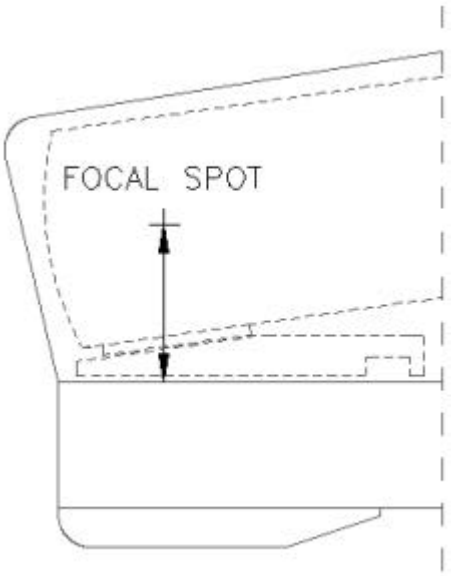
After the above configuration of Focal Spot Position:

- set Paddle Position Offset to zero
- store configuration values into the Mammo unit
- install a shifted compression paddle

- put a semi-rigid sponge under the compression paddle and compress
- read the Source to Skin distance from the display pushing, in Manual Mode, the BELL button together with kV(-) button
- measure the Source to Skin distance between Tube Focal Spot and lower surface of compression paddle
- input the difference in mm. between the two values in the “Paddle Offset” box
- store configuration values into the Mammo unit
- check that now Source to Skin distance on the display is correct.

The measurement at these parameters takes into account the deformations of the compression system as recommended at clause A3.2.1 of the European Protocol of Dosimetry in Mammography.
Correct Dosimeter operation is guaranteed only if correct configurations as described in the Operator’s manual are respected.

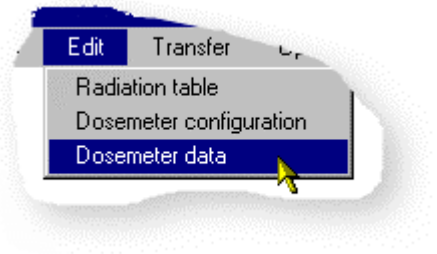
FOCAL SPOT DISTANCE
The focal spot distance above the upper plane of the arm can depend on the specific tube installed.



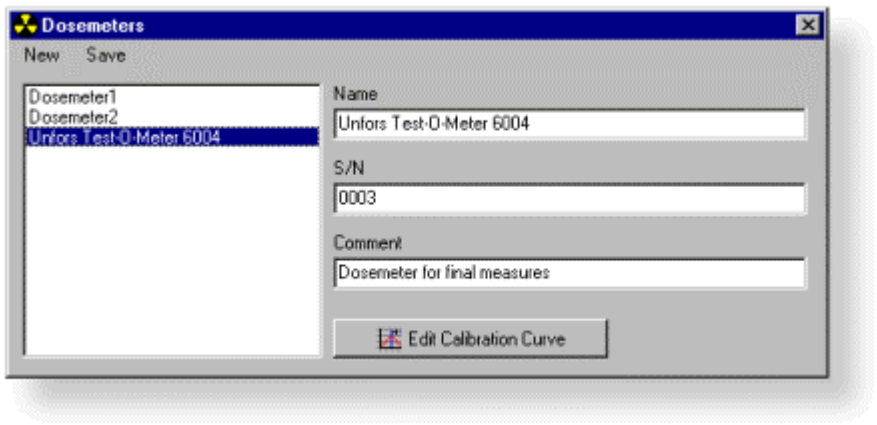
The correct measurement of this parameter is crucial for the measure accuracy of the Dose.
Using a calliper, measure the distance in mm. and input the value in the box “ Focal Spot distance (mm)”

ANODE CURRENT @ 28kV
For Tube Output and Tube Dose Rate calculations, value in mA of Anode Current @ 28kV in Manual Mode is essential, typical value is 90mA but in any case refer to Tube Calibration report for specific value.

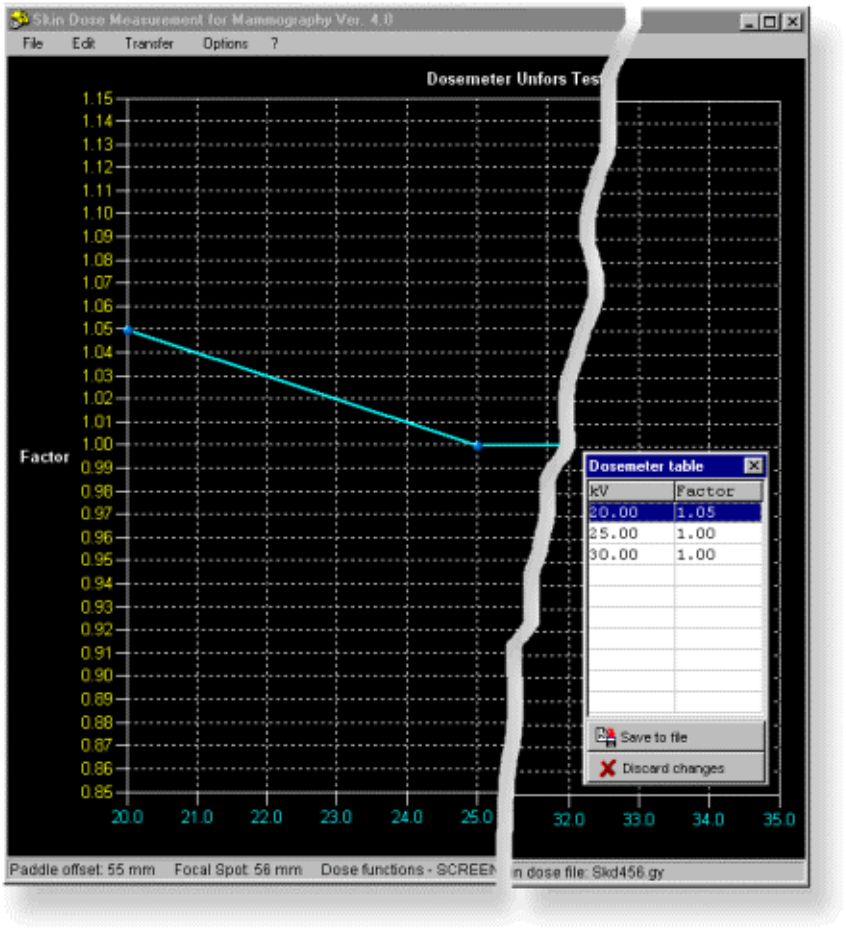
Dosemeter data



You can define dosemeter instruments for use in fine tuning measure readout. Just press the "Edit"-"Dosemeter data" menu.

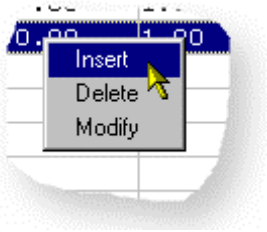


The "Dosemeters" window opens, with edit fields all editable. To define a new instrument, press the "new" menu. A "default" dosemeter is inserted in the left list. Now you can select it in the list (as with an existing one) and type the correct informations in corresponding edit fields on the right. To modify the response curve for the instruments (the default is a plateau curve) press the "Edit calibration curve" pushbutton.

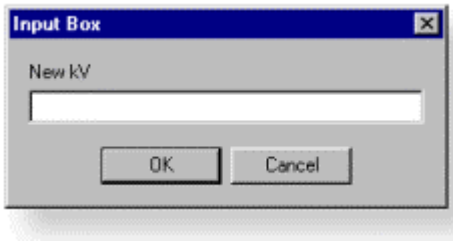


The curve is drawn on the canvas of the main window, while data are reported into a separated window, from which you can edit them. This window is always "on the top" and you can move it to discover parts of the graphic below, but if you close it, the graphic disappears too.

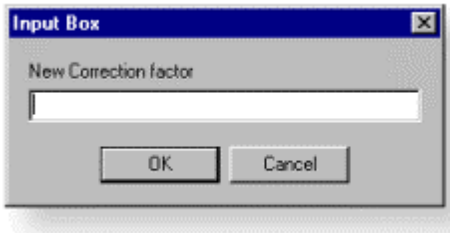
Data are presented in a "kV" versus "Correction factor" grid. Any row corresponds to a point of the curve.



To insert a new value in the table, right-click the mouse over an existing one and choice "Insert".

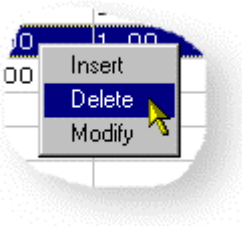


A "New kV" dialog pops-up. Type the desired new value and press OK.

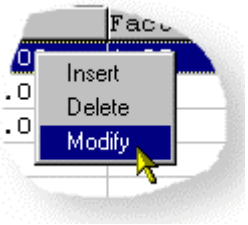


A "New Factor" dialog pops-up. Type the desired new value and press OK. The table, and the graph below, are updated. The ranges of possible values for kV and Factor are those shown in the graph axes. Any value outside this ranges pops-up an error message and quits the

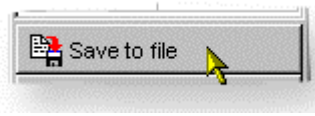
procedure.



To delete a value in the table select the row, right-click the mouse and choice "Delete". The table, and the graph below, are updated.



To modify an existing value either select the row, right-click the mouse and choice "Modify" or doubleclick the row. Follow the steps as in "Insert". The input dialogs show the actual value for the editing fields. At the end, the table, and the graph below, are updated.



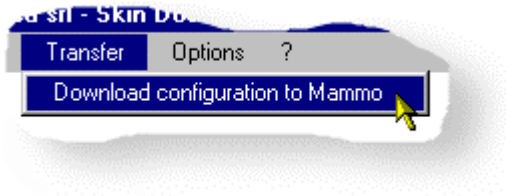
Finally, once all changes are made, you can save modifications to file...

...or discard them and return to main window.

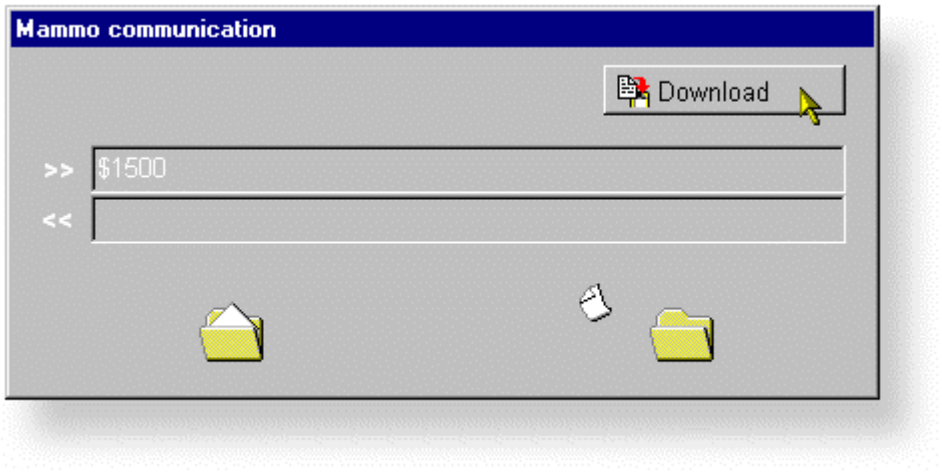
Communications with mammo unit

Downloading configuration data

Once a configuration is completely defined you can download it to the mammo unit.



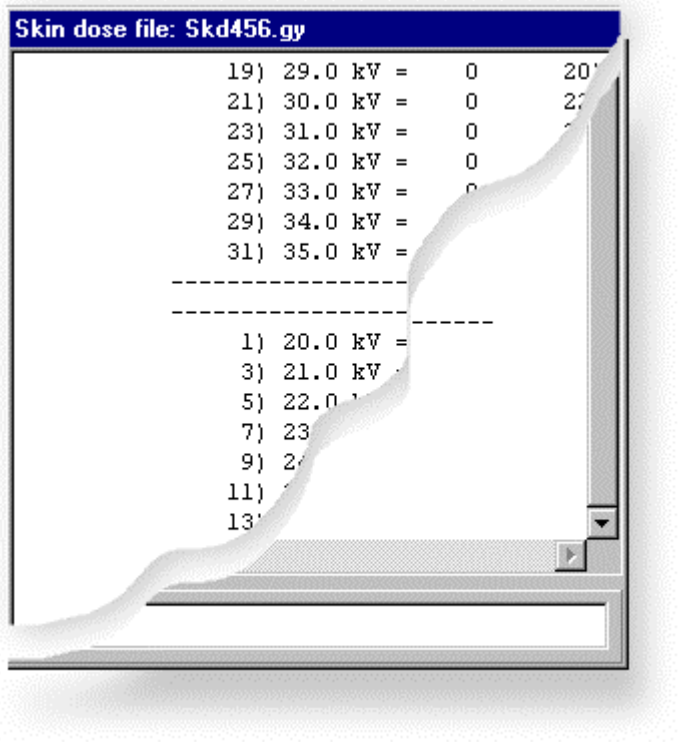
To download configuration data to mammo unit you must select the "Transfer"-"Download configuration to mammo" menu.



A window pops-up with edit fields reporting characters outcoming to and incoming from the serial port. Press "Download" pushbutton to start the transfer. Once completed, a little dialog tells the status of the transfer, either good or bad.

Options

The only option available is the visualization of the configuration file.



This file contains text data related to parameters and radiation values constructed by the program.

Compression system

Introduction

The compression device of MAMMOMAT BALANCE consists of a drive motor MT3 with gear box **08883659** coupled to an electromagnetic clutch **08883634**.
To access drive motor, remove tube cover.
To access electromagnetic clutch remove tube cover and c-arm front plate.
Compression force is adjusted by means of current flowing in the electromagnetic clutch that also has safety function.
Drive motor has current sensing circuit for speed reduction when compression plate gets in contact with the breast.
For function description refer to Operator's manual **SPB7-115.620.01…**

Configuration of Maximum compression force

Maximum compression force of 150 N or 200 N is selected by means of

SW2		
DIP3 =	**ON**	Max compression force 200N

Index number on the display will change accordingly to maximum force selected.

Calibration of Maximum compression force

Maximum compression force of 150 N or 200 N is calibrated by means of

SW1		
DIP7 =	**ON**	Compression force calibration

Insert shifted compression plate **8383197**, position a bathroom balance on the table and a soft cushion between plate and balance as alternate method, spring balance can be used.
Compression force can be adjusted changing the correction factor from 1 to 20 that will appear on the display in place of compression force.
Correction factor can be changed by means of mAs [+] [-] pushbuttons.
To the lowest correction factor corresponds the highest compression force and vice versa.

Motor current detector

For proper functionality of plate speed reduction, motor current detector is factory calibrated.

Motor or clutch replacement

If motor or clutch are replaced take care of correct alignment between clutch surfaces.
Correct alignment is essential for compression force constancy and reproducibility.
After replacement check and eventually calibrate compression force.

C-arm Rotation brake

C-arm rotation brake is made of a disk brake.
Disk brake caliper is operated by means of motor with gear box **08883659.**
Brake locked unlocked positions are detected by means of **MW5** and **MW6**, **08883782** microswitches.

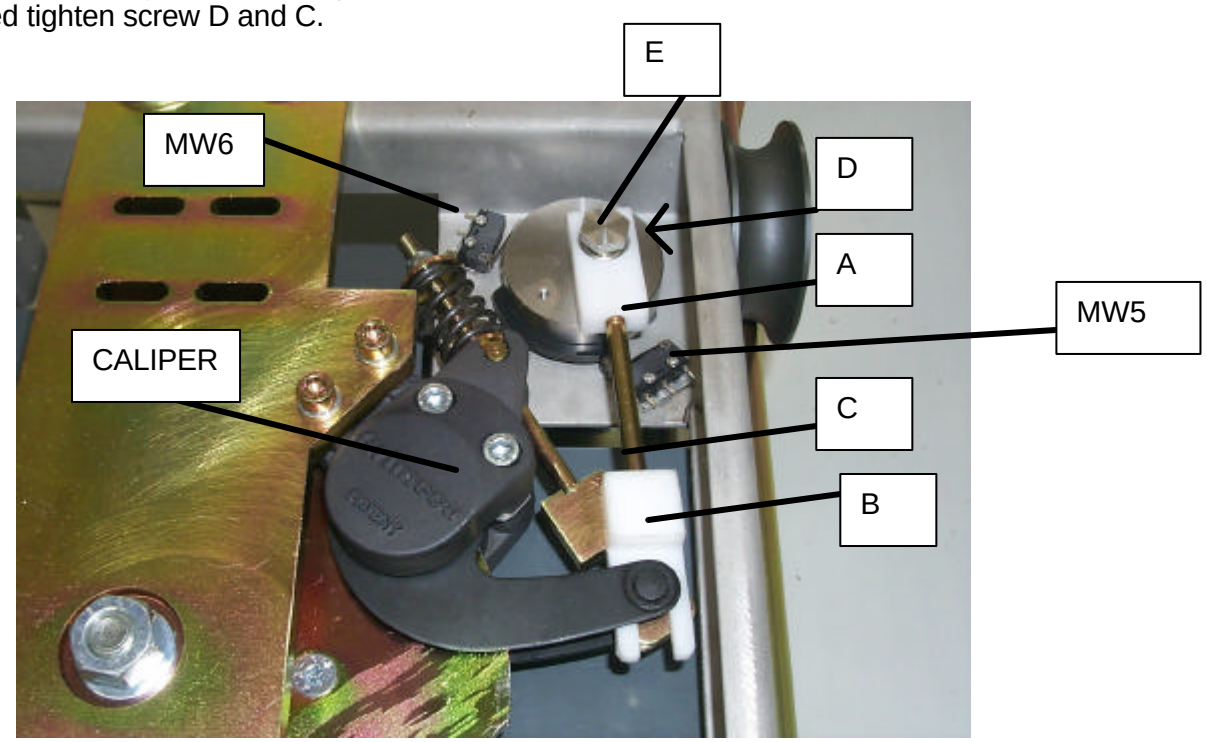
		LOCKED	UNLOCKED
MW5	CN32 PCB 03-188 pin 2	+5 Vdc	0 Vdc
MW6	CN32 PCB 03-188 pin 3	0 Vdc	+5 Vdc

Motor MT3 is connected to CN21 PCB 03-188
Cable CV0161 connects Motor and microswitches to PCB 03-188
If sensing microswitches are defective, motor turns continuously and lock unlock function doesn't work properly.
For easy static investigation of brake problems, DIP1 of SW2 is provided to disable C-arm motor.

SW2		
DIP1 =	**ON**	C-arm Brake, disabled for service

Brake force adjustment

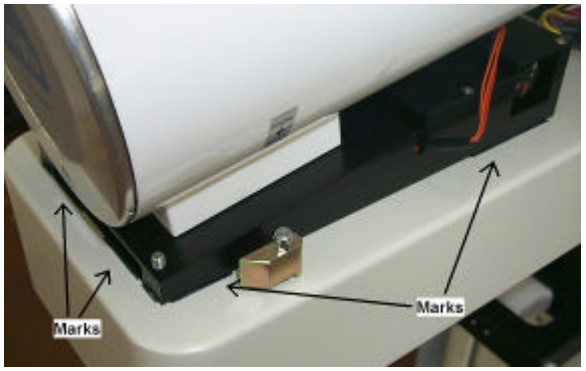
Brake force is adjusted increasing decreasing distance between the two white plastic parts A / B connected by means of screw C.
Partially unscrew the little screw D that stays on the side of the cylinder, and totally screw E.
Turn part B as necessary, reassemble parts and check for effect on brake force.
When finished tighten screw D and C.



X-ray / light field alignment procedure

Assembly / disassembly of original tube

If original tube has to be disassembled, take care to align it with marks when reassembling it.

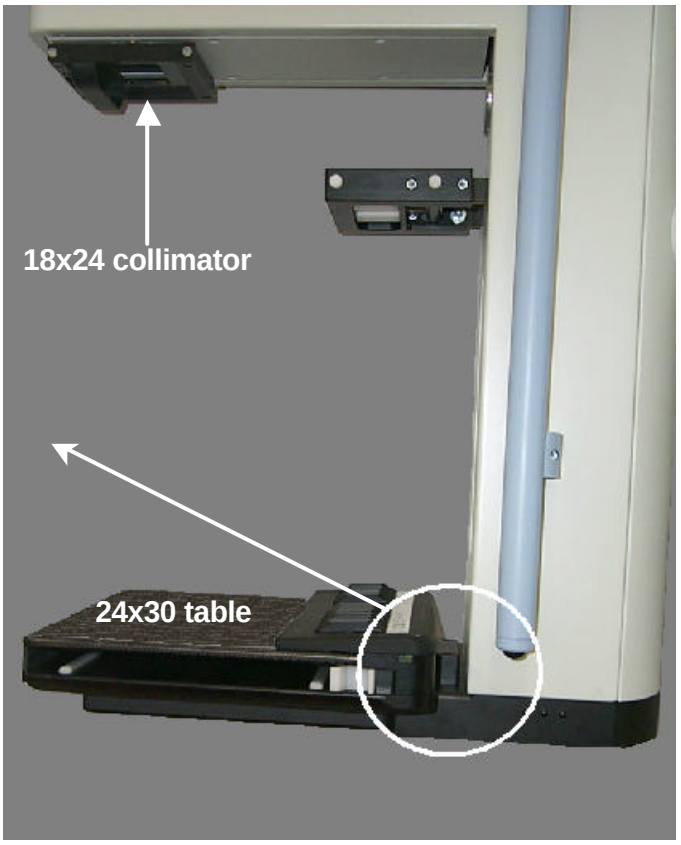


X-RAY Beam collimation

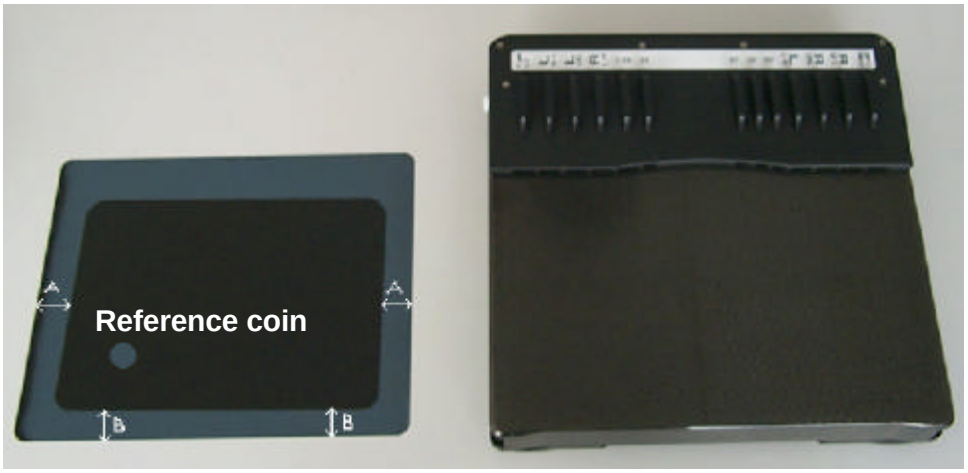
To verify or align x-ray beam, grid **8383221** or gridless **8383239** 24x30 table is necessary.

- Insert a film in a 24x30 table, and insert the table in the slide guide up to align it precisely with the contact on the C-arm (see figure). In this position the potter is 22 mm ahead than its usual position.

The table is aligned exactly with the contacts of the C-arm.



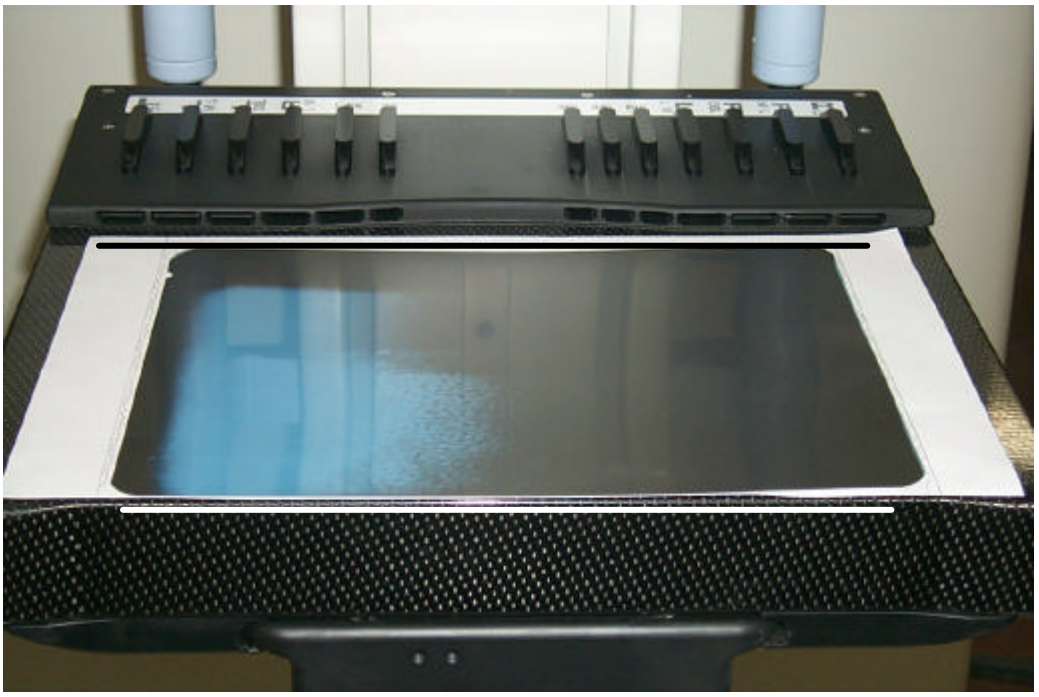
- Insert a 18x24 cm collimator **8383205**.
- place a coin on a corner of the table as a reference, expose with 26 kV 40 mAs and develop the film.
- Measure the two distances ***A*** between the side border and the dark zone of the film. Measure the two distances ***B*** between the film front edge and the dark zone of the film (see figure). The measures must be taken starting from the darker zone of the film, because the shaded zone is not useful.



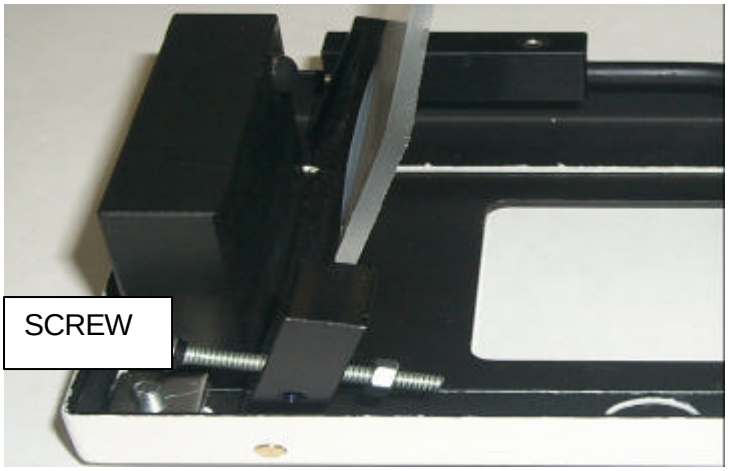
- The two distances ***A*** must be the same (excluding the clearance of the film in the cassette).
- The two distances ***B*** must be the same within 1 mm. They must be included between 17 mm and 22 mm.
- If the two distances *A* are not the same, it is necessary to trim the position of the RX tube shifting it to the right if the right distance is shorter than left, and vice versa. Consider that shifting the tube for 1 mm causes the shifting of the borders of about 4 mm.
- If the two distances *B* are more than 22 mm, it is necessary to trim the position of the RX tube shifting it back. If the distances are less of 17 mm, it is necessary to shift the tube ahead. To shift the tube, operate the screws shown in the next picture .

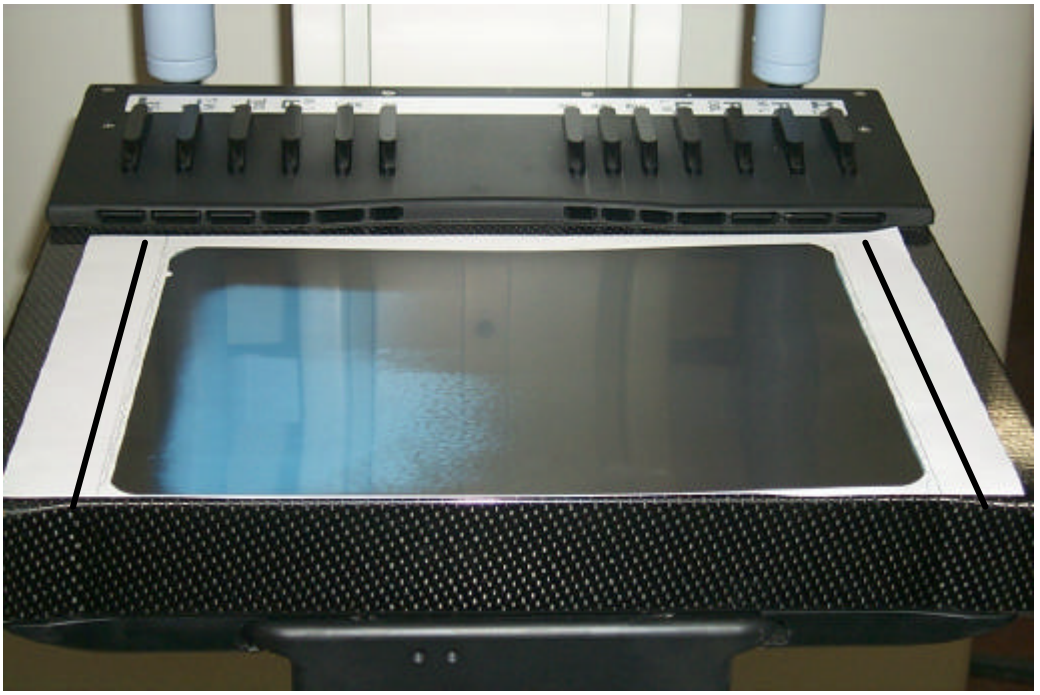
Light / Beam alignment

Adjustment of the light field is necessary only if light beam collimator is disassembled.
To inspect light beam field use again a 24x30 table fully inserted as for normal use with a A3 format paper and an 18x24 film on it, insert an 18x24 collimation plate.
Position 18x24 film as in the next picture to simulate x-ray field.



To correct front back edges of light field, adjust mirror inclination by means of screw .





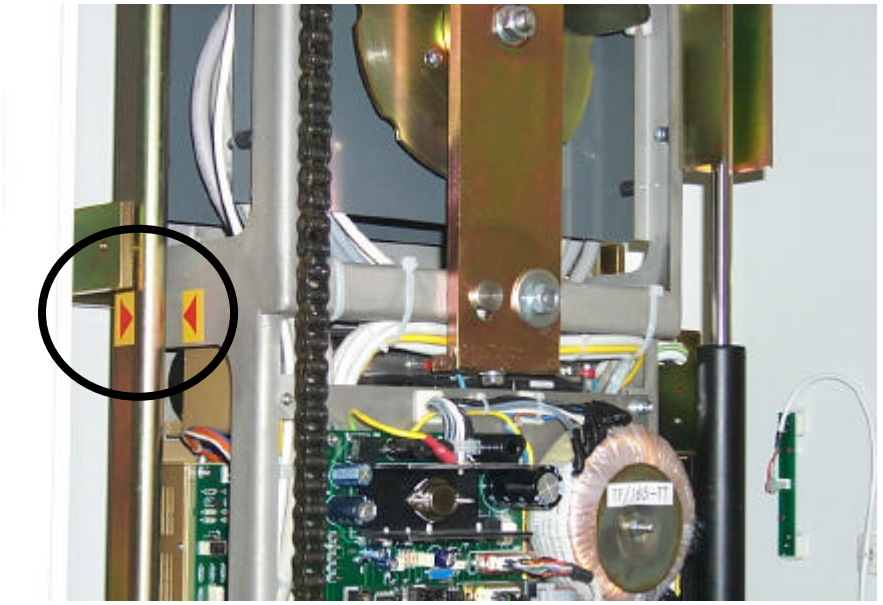
To correct lateral edges of light field, adjust lamp holder position by means of screws .

Gas spring replacement

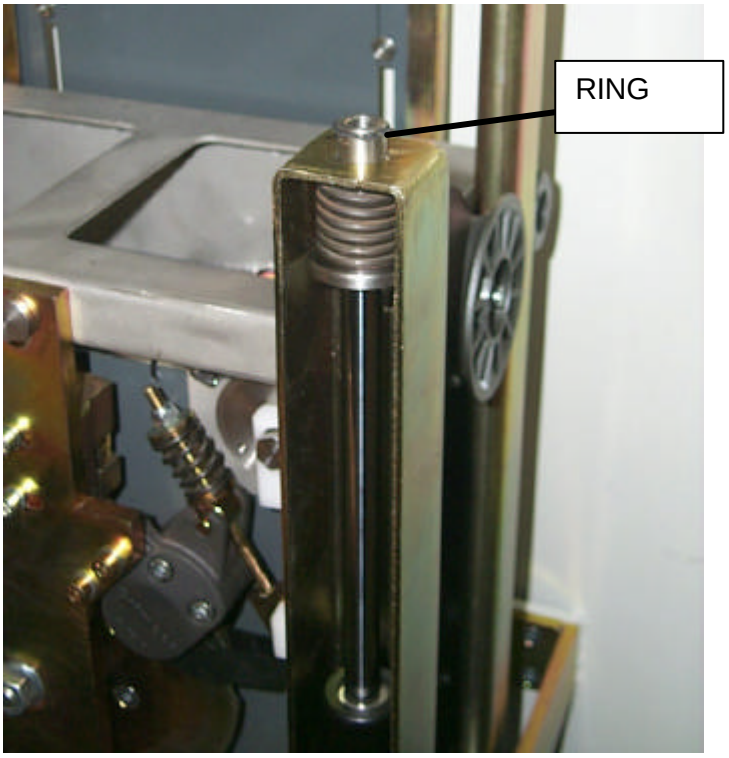
Gas spring assembly is made of two gas springs **08896479** + **08896487** with a jacket **08884293**
When gas spring becomes defective MW 7 Sensing microswitch opens and specific alarm is generated at control panel.

To replace gas spring assembly :

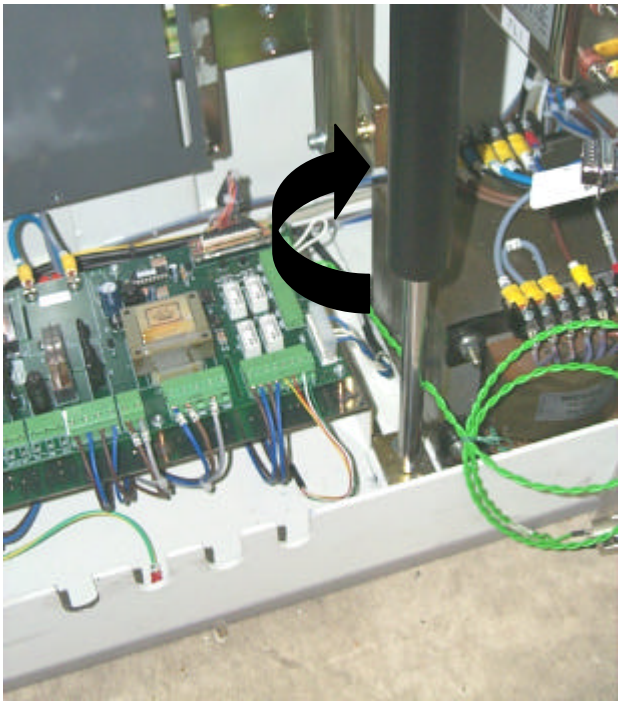
1. Switch OFF the unit and turning manually flywheel of carriage motor, move carriage till to align arrows as shown in the next image



2. remove fixing ring from the shaft



3. unscrew gas spring from the base plate



4. replace gas spring assembly. Reassembling gas spring, take care of positioning sensing microswitch shaft without damaging it.

MAMMOMAT Balance / Easy Label communication protocol

Description of characters and position, from 1 to 44

1	>	
2	5	Line number on EASY LABEL screen
3		
4	X	Kv tens
5	X	kV units
6		.
7	X	kV tenths
8	k	
9	V	
10		
11	X	mAs hundreds
12	X	mAs tents
13	X	mAs units
14		.
15	X	mAs tenths
16	m	
17	A	
18	s	
19		
20		. .
21	X	Dimension of focal spot
22	X	
23		
24	X	type of ANODE Mo, W
25	X	
26	/	
27	X	type of FILTER Mo, Rh
28	X	
29	Y	tecnique kV ZERO POINTS s=Standard h=HIGH CONTRAST l=LOW DOSE e=EXTENDED
30		
31	X	G = with grid space = without grid
32		
33	X	0P = ZERO POINTS 1P = ONE POINT
34	X	
35		
36	D	manual density
37	X	+/-
38	X	number of step from –5 a +5
39		
40	F	film/screen
41	X	film screen number from 1 to 15
42	X	
43	$5C	
44	$0D	

DOSE IF ENABLED

- 4800 baud speed
- 8 bits
- 1 stop bit
- no parity
- ASCII line of 44 characters
- KV min 20.0 KV max 35.0 KV
- mAs min 0.1 mAs max 640.0 mAs
- Dimension of focal spot
- Manual density +/- 5
- Film/Screen 1/16 combination
- The string is transferred once at the end of the exposure.

Changes to Previous Version

Chapter	Page	Change
Control LEDs	8	... bright fix during grid movement.
Control LEDs	8	Filament power supply PCB 92-073
Operating Errors On Display	16	NOT ACTIVE
Technical menu; Rotating anode 92-074 >> FAIL <<	19	…of jumpers on CN5 PCB 01-170 or flat cable CV0174. Picture changed
Technical menu; Inverter	20	Led DL1 ...of Jumpers on CN3 PCB 01-170 Picture changed ...Vdc (in)= 000 then F3 of PCB…
Technical errors in LOG file	20	Better text and images to download last 1300 events from mammo
List of Error Codes	22	NOT ACTIVE
Calibration of protection circuit	23	Picture changed
Anode current calibration	29	To enter **mAL** current calibration set **DIP2 of SW1**
Accessing the program	39	Creation of a new Dosemeter file removed: change in text and images
Radiation table	43	... in a "kV" versus reference dose grid. Any row…
Dosemeter configuration	45	Picture of Dosemeter configuration window changed.
Dosemeter configuration	46	... display pushing, in Manual Mode, the BELL… FOCAL SPOT DISTANCE
Introduction	51	…refer to Operator's manual **SPB7-115.620.01…**
Configuration of maximum compression force	51	... correction factor from 1 to 20 that will…
Brake force adjustment	52	Better text and image